

**US Army Corps
of Engineers®**

Seattle District

FY03 Whole Barracks Renewal

Fort Lewis, WA

Construction Solicitation and Specifications

UNRESTRICTED

JAN 2003

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THIS PROCUREMENT IS:

Open to both Large and Small Business.

FORT LEWIS SITE VISIT INFORMATION:

- A one-time site visit for offerors is scheduled for 8:30 AM, 28 January 2003. Prospective attendees should arrive at the Visitors Center no later than 7:00 A.M., Local Time. Meeting is to be held at the U.S. Army Corps of Engineers Fort Lewis Area Office (FLAO), Building 2015 3rd floor, Fort Lewis, Washington. A temporary 1-day vehicle pass is required to drive on Fort Lewis and may be obtained from the Visitor's Center at the Fort Lewis Main Gate.
- To receive the temporary pass, transmit an email containing the following information to Charlotte Jenks at **charlotte.jenks@nws02.usace.army.mil**.
 1. Name of the Project Manager
 2. Site visit time and date
 3. Name of company
 4. Names of prospective attendees
 5. Drivers License Numbers and dates of birth of prospective attendees

NOTE: EMAIL MUST BE SENT AT LEAST FIVE BUSINESS DAYS BEFORE THE SITE VISIT DATE.

- To receive passes, visitors should be at the main gate Visitor's Center at least one and a half hours before the site visit. When arriving at the Visitor's Center, all visitors will present a valid drivers license, current vehicle registration, proof of insurance and must state their post destination (i.e. Corps of Engineers, Ft. Lewis Area Office). Visitors will have proof of insurance, vehicle registration, and drivers license at all times while driving on base.
- DIRECTIONS TO FORT LEWIS AREA OFFICE: Take I-5, to exit 121 (Fort Lewis/North Fort Lewis), follow the signs to Fort Lewis and proceed to the Visitor's Center, just inside and to the right of the Main Gate. After receiving a visitor pass, proceed onto the base on Division to the third traffic light. Turn right at the 3rd traffic light onto Pendleton Avenue. Building 2015 will be on the left at the blinking yellow light behind the Fire Station. Parking is available across the street from building 2015. The Area Office is on the 3rd floor.
- OFFERORS ARE URGED and expected to inspect the site where construction is to be performed and to satisfy themselves as to all general and local conditions which may affect the cost of performance of the contract, to the extent, such information is reasonably obtainable. In no event, will a failure to inspect the site constitute grounds for withdrawal of a proposal after opening or for a claim after award of the contract.

PROPOSAL DOCUMENTS: All proposal documents, including planholder's lists, are posted at the Seattle District Internet site: <http://www.nws.usace.army.mil/ct/>. Registered firms receive email notification of updates/amendments.

FOR INQUIRIES, CONTACT THE FOLLOWING:

TECHNICAL MATTERS: Address questions concerning plans and or specifications to the following internet address: techbid@nws02.usace.army.mil.

ADMINISTRATIVE MATTERS: Thomas R. DeGonia

E-mail: Thomas.R.DeGonia@nws02.usace.army.mil

Traditional Mail: Seattle District Corps of Engineers, P.O. Box 3755, Seattle, WA 98124-3755

Street Address: 4735 E. Marginal Way S., Seattle, WA 98134-2385

Monday through Friday between the hours of 8:00 a.m. and 3:00 p.m.

Phone: (206) 766-6449 Fax: (206) 764-6817

DACA67-03-R-0205

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TABLE OF CONTENTS

CAUTION TO OFFERORS

<u>SECTION</u>	<u>TITLE</u>
SF1442	Pages 00010-1 through 00010-6 (page 00010-3 is reserved) and Subcontracting Letter (pages 00010-7 thru 00010-13)
00100	Instructions, Conditions and Notice to Offerors
00110	Proposal Submissions and Evaluation
00600	Representations and Certifications and Other Statements of Offerors
00700	Contract Clauses
00800	Special Clauses, which include the following: <ul style="list-style-type: none">1. Special Clauses: Pages 00800-1 thru 00800-202. Davis-Bacon General Wage Decisions:<ul style="list-style-type: none">a. No. WA020001b. No. WA020002c. No. WA020014
01000	Technical Specifications: Sections 01000 thru 16711

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!!!CAUTION TO OFFERORS !!!

1. **TELEPHONES:** Limited telephone service is provided in the lobby. Only two public telephones may be used by offerors for completing offers.
2. **BUSINESS HOURS:** For the Seattle District Corps of Engineers are from 7:30 A.M. to 4:00 P.M., Monday through Friday.
3. **AVAILABILITY OF FUNDS:** Funds are not presently available for this acquisition. No contract award will be made until appropriated funds are made available from which payment for contract purposes can be made.

BEFORE SIGNING AND MAILING THIS OFFER, PLEASE TAKE NOTE OF THE FOLLOWING, AS FAILURE TO PERFORM ANY ONE OF THESE ACTIONS MAY CAUSE YOUR OFFER TO BE REJECTED

4. **AMENDMENTS:** Have you acknowledged receipt of ALL amendments? All amendments are posted at the Contracting web site: <http://www.nws.usace.army.mil/ct/ebs/AdvertisedSolicitations.asp>
5. **AMENDED PAGES:** If any of the amendments furnished amended pages, the amended pages must be used in submitting your offer.
6. **MISTAKE IN OFFER:** Have you reviewed your offer price for possible errors in calculation or work left out?
7. **BID GUARANTEE:** Sufficient bid guarantee in proper form must be furnished with your offer.
NOTE: CONCERNING BONDS – Matter of All Seasons Construction, Inc. GAO Decision B-291166.2: Bid Bonds must be accompanied by a Power of Attorney containing an original signature from the surety, which must be affixed to the Power of Attorney after the Power of Attorney has been generated. Computer generated and signed Power's of Attorney will only be accepted if accompanied by an original certification from a current officer of the surety attesting to its authenticity and continuing validity.
8. **TELEGRAPHIC MODIFICATIONS:** The Seattle District does not have the capability of receiving commercial telegrams directly. Offerors who wish to modify their offer by telegram are urged to ensure that telegrams are submitted within enough time to arrive at the opening office prior to the time specified for receipt of proposals. Any doubt as to time should be resolved in favor of EXTRA TIME. Transmission by Fax to this office is NOT ACCEPTABLE.
9. **OFFER ACCEPTANCE PERIOD:** The minimum offer acceptance period is specified in block 13D of SF1442-1, Solicitation, Offer and Award. Please ensure that you allow at least the stated number of calendar days for the Government to accept your offer.
10. **CENTRAL CONTRACTOR REGISTRATION:** Your attention is drawn to DFARS Clause 252.204-7004, REQUIRED CENTRAL CONTRACTOR REGISTRATION in section 00100. Lack of registration in the CCR database will make offeror ineligible for award. Information on how to register and the time it takes are detailed in the clause.

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SOLICITATION, OFFER, AND AWARD <i>(Construction, Alteration, or Repair)</i>	1. SOLICITATION NUMBER DACA67-02-R-0205	2. TYPE OF SOLICITATION <input type="checkbox"/> SEALED BID (IFB) <input checked="" type="checkbox"/> NEGOTIATED (RFP)	3. DATE ISSUED 17 January 2003	PAGE OF PAGES 1
	IMPORTANT - The "offer" section on the reverse must be fully completed by the offeror.			
4. CONTRACT NUMBER	5. REQUISITION/PURCHASE REQUEST NUMBER W68MD9-2309-1321	6. PROJECT NUMBER		
7. ISSUED BY Seattle District, Corps of Engineers ATTN: CENWS-CT-CB-MU PO Box 3755 Seattle, WA 98124-3755	CODE W68MD9	8. ADDRESS OFFER TO Seattle District, Corps of Engineers PO Box 3755 ATTN: CENWS-CT-CB-MU/DeGonia Seattle, WA 98124-3755 HAND CARRY: Seattle District Corps of Engineers Contracting Division 4735 East Marginal Way South Seattle, WA 98134-2385		
9. FOR INFORMATION CALL 	A. NAME See Information Page inside Front Cover	B. TELEPHONE NUMBER <i>(Include area code) (NO COLLECT CALLS)</i> See Information Page inside Front Cover		

SOLICITATION

NOTE: In sealed bid solicitations "offer" and "offeror" mean "bid" and "bidder".

10. THE GOVERNMENT REQUIRES PERFORMANCE OF THE WORK DESCRIBED IN THESE DOCUMENTS *(Title, identifying number, date):*

Furnish all labor, materials and equipment and perform all work for FY03 Whole Barracks Renewal, Fort Lewis, WA in accordance with the attached Contract Clauses, Special Clauses, Technical Specifications and Drawings.

NOTE: Award will be made pursuant to the Small Business Competitive Demonstration Program

11. The Contractor shall begin performance within <u>10</u> calendar days and complete it within <u>720</u> calendar days after receiving <input type="checkbox"/> award, <input checked="" type="checkbox"/> notice to proceed. This performance period is <input checked="" type="checkbox"/> mandatory, <input type="checkbox"/> negotiable. <i>(See SC-1, 00800 .)</i>	
12A. THE CONTRACTOR MUST FURNISH ANY REQUIRED PERFORMANCE PAYMENT BONDS? <i>(If "YES," indicate within how many calendar days after award in Item 12B.)</i> <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	12B. CALENDAR DAYS 10
13. ADDITIONAL SOLICITATION REQUIREMENTS:	
A. Sealed offers in original and <u>0</u> copies to perform the work required are due at the place specified in Item 8 by <u>2:00 p.m.</u> <i>(hour)</i> local time <u>20 February 2003</u> <i>(date)</i> . If this is a sealed bid solicitation, offers will be publicly opened at that time. Sealed envelopes containing offers shall be marked to show the offeror's name and address, the solicitation number, and the date and time offers are due.	
B. An offer guarantee <input checked="" type="checkbox"/> is, <input type="checkbox"/> is not required.	
C. All offers are subject to the (1) work requirements, and (2) other provisions and clauses incorporated in the solicitation in full text or by reference.	
D. Offers providing less than <u>90</u> calendar days for Government acceptance after the date offers are due will not be considered and will be rejected.	

OFFER (Must be fully completed by offeror)

14. NAME AND ADDRESS OF OFFEROR (Include ZIP Code)

15. TELEPHONE NUMBER (Include area code)

Fax No.:

16. REMITTANCE ADDRESS (Include only if different than Item 14)

Tax ID No:
eMail:

DUNS No:

CODE

FACILITY CODE

17. The offeror agrees to perform the work required at the prices specified below in strict accordance with the terms of this solicitation, if this offer is accepted by the Government in writing within _____ calendar days after the date offers are due. (Insert any number equal or greater than the minimum requirement stated in 13D. Failure to insert any number means the offeror accepts the minimum in Item 13D.)

AMOUNTS



18. The offeror agrees to furnish any required performance and payment bonds.

19. ACKNOWLEDGEMENT OF AMENDMENTS

(The offeror acknowledges receipt of amendments to the solicitation - give number and date of each)

AMENDMENT NO.

DATE

20A. NAME AND TITLE OF PERSON AUTHORIZED TO SIGN OFFER (Type or print)

20B. SIGNATURE

20C. OFFER DATE

AWARD (To be completed by Government)

21. ITEMS ACCEPTED

22. AMOUNT

23. ACCOUNTING AND APPROPRIATION DATA

24. SUBMIT INVOICES TO ADDRESS SHOWN IN
(4 copies unless otherwise specified)

ITEM

25. OTHER THAN FULL AND OPEN COMPETITION PURSUANT TO

☐ 10 U.S.C. 2304(c) ()☐ 41 U.S.C. 253(c) ()

26. ADMINISTERED BY

CODE

United States Army Corps of Engineers Seattle District
Northwest Area Office
PO Box 92146
Tillicum, WA 98492-0146

27. PAYMENT WILL BE MADE BY

US Army Corps of Engineers Finance Center
CEFC-AO-P, 5722 Integrity Drive
Millington, TN 38054-5005

CONTRACTING OFFICER WILL COMPLETE ITEM 28 OR 29 AS APPLICABLE

28. NEGOTIATED AGREEMENT (Contractor is required to sign this document and return _____ copies to the issuing office.) Contractor agrees to furnish and deliver all items or perform all work requirements identified on this form and any continuation sheets for the consideration stated in this contract. The rights and obligations of the parties to this contract shall be governed by (a) this contract award, (b) the solicitation, and (c) the clauses, representations, certifications, and specifications incorporated by reference in or attached to this contract.



29. AWARD. (Contractor is not required to sign this document.) Your offer on this solicitation is hereby accepted as to the items listed. This award consummates the contract, which consists of (a) the Government solicitation and your offer, and (b) this contract award. No further contractual document is necessary.

30A. NAME AND TITLE OF CONTRACTOR OR PERSON AUTHORIZED TO SIGN
(Type or print)

31A. NAME OF CONTRACTING OFFICER (Type or print)

30B. SIGNATURE

30C. DATE

31B. UNITED STATES OF AMERICA

BY

31C. AWARD DATE

Contract No.: _____

IF THE CONTRACTOR IS A CORPORATION OR PARTNERSHIP, THE APPLICABLE FORM LISTED BELOW MUST BE COMPLETED. IN THE ALTERNATIVE, OTHER EVIDENCE MUST BE SUBMITTED TO SUBSTANTIATE THE AUTHORITY OF THE PERSON SIGNING THE CONTRACT. IF A CORPORATION, THE SAME OFFICER SHALL NOT EXECUTE BOTH THE CONTRACT AND THE CERTIFICATE.

CORPORATE CERTIFICATE

I, _____, certify that I am the _____ Secretary of the corporation named as Contractor herein; that _____ who signed this contract on behalf of the Contractor was then _____ of said corporation; that said contract was duly signed for and on behalf of said corporation by authority of its governing body and is within the scope of its corporate powers.

(Secretary) (CORPORATE SEAL)

AUTHORITY TO BIND PARTNERSHIP

This is to certify that the names, signatures and Social Security Numbers of all partners are listed below and that the person signing the contract has authority actually to bind the partnership pursuant to its partnership agreements. Each of the partners individually has full authority to enter into and execute contractual instruments on behalf of said partnership with the United States of America, except as follows: (state "none" or describe limitations, if any).

This authority shall remain in full force and effect until such time as the revocation of authority by any cause whatsoever has been furnished in writing to, and acknowledged by, the Contracting Officer.

(Names, Signatures and Social Security Numbers of all Partners)

NAME	SIGNATURE	SOCIAL SECURITY NO.
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

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SCHEDULE

<u>Item No.</u>	<u>Description of Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>
0001	All Work for FY 03 Whole Barracks Renewal, Except for Items 0002 through 0015	1	JOB	L.S.	\$_____
0002	All Work for Two Barrack A Buildings	1	JOB	L.S.	\$_____
0003	All Work for Two Barrack B Buildings	1	JOB	L.S.	\$_____
0004	All Work for Two Barrack C Buildings	1	JOB	L.S.	\$_____
0005	All Work for Two Soldier Community Buildings	1	JOB	L.S.	\$_____
0006	All Work for the Large Battalion Headquarters Building	1	JOB	L.S.	\$_____
0007	All Work for Two Medium Company Operations Buildings	1	JOB	L.S.	\$_____
0008	All Work for Five Lawnmower Storage Buildings	1	JOB	L.S.	\$_____
0009	All Landscape and Irrigation Work for Echo Block, Except for Item 0011	1	JOB	L.S.	\$_____
0010	All Landscape Work for 41st Division Drive and Related Areas, Except for Items 0011 and 0012	1	JOB	L.S.	\$_____
0011	All Work for Removal and Offsite Disposal of Scot's (Scotch) Broom (Cytisus scoparius) at 41st Division Drive Project				
0011AA	First 15,600 Square Meters	15,600	M ²	15,600	\$_____
0011AB	All Over 15,600 Square Meters	2,000	M ²	2,000	\$_____
0012	All Work to Provide Landscape Maintenance and Irrigation Maintenance for One-Year Plant Establishment Period (see Specification 02935).	1	JOB	L.S.	\$_____
0013	All Work for As-Built Drawings as Specified in Section 01702 from Preparation to Final Approval	1	JOB	L.S.	\$30,000.00
0014	All Work for O&M Manuals as Specified in	1	JOB	L.S.	\$75,000.00

<u>Item No.</u>	<u>Description of Item</u>	<u>Quantity</u>	<u>Unit</u>	<u>Unit Price</u>	<u>Amount</u>
	Section 01701 from Preparation to Final Approval				
0015	All Work for Form 1354 Checklist and Equipment in Place List as Specified in Sections 01704 and 01705 from Preparation to Final Approval	1	JOB	L.S.	\$15,000.00
TOTAL					\$_____

NOTE: The dollar amounts established in Items No. 0013, 0014, and 0015 shall not be revised by bidders.



REPLY TO
ATTENTION OF

DEPARTMENT OF THE ARMY
SEATTLE DISTRICT, CORPS OF ENGINEERS
P.O. BOX 3755
SEATTLE, WASHINGTON 98124-3755

Contracting Division

REV Nov 19, 2002

SUBJECT: DACA67-03-R-0205, FY 03 Whole Barracks Renewal, Fort Lewis, Washington

NOTICE TO LARGE BUSINESS FIRMS: (RFP)

Your attention is directed to the contract clauses entitled "Utilization of Small Business Concerns (Oct 2000) (52.219-0008) and "Small Business Subcontracting Plan" (Jan 2002) (52.219-0009II), which are included in this solicitation. If you are a large business, and your offer is **\$1,000,000** or more you are required to submit a subcontracting plan **with** your proposal. Award will not be made under this solicitation without a subcontracting plan approved by the Contracting Officer.

DEFINITIONS: "Subcontract" means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime contractor or subcontractor calling for supplies and/or services required for performance of the contract or subcontract.

For your information, we consider the following goals reasonable and achievable during the performance of the contract resulting from this solicitation. However, final goals will be negotiated prior to contract award. The Subcontracting Plan will then become a material part of your contract.

- a. 65% of planned subcontracting dollars can be placed with all small business concerns.
- b. 9% of planned subcontracting dollars can be placed with those small business concerns owned and controlled by socially and economically disadvantaged individuals or Historically Black Colleges and Universities or Minority Institutions. NOTE: b. is a subset of a.
- c. 5% of planned subcontracting dollars for small women-owned businesses. NOTE: c. is a subset of a. Also, the women-owned business may meet the definition of a small disadvantaged business. If so, c. will also be a subset of a. (Count firm in all applicable areas.)
- d. 10% of planned subcontracting dollars may be placed with HUBZone small business concerns. NOTE: d. is a subset of a. Note: A HUBZone firm may also SDB, women-owned and/or veteran-owned. Count firm in all applicable areas).
- e. 3% of planned subcontracting dollars for veteran-owned small business. NOTE: e. is a subset of a. Go to <http://www.va.gov/osdbu/vetctr.htm> or <http://www.sba.gov/VETS/> for questions concerning the Veterans Business Development program.
- f. 2% of planned subcontracting dollars may be placed with service-disabled veteran-owned small business. NOTE: f. is a subset of a. and e.

The acceptability of percentaged goals will be determined on a case-by-case basis depending on the supplies/services involved, the availability of potential small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBzone small business concerns, small disadvantaged business concerns, and women-owned small business concerns and prior experience. Once approved and implemented, plans will be monitored through the submission of periodic reports and, as time and availability of funds permit, periodic visits to subcontractors facilities to review applicable records and subcontracting program progress.

Goals included in any proposed plan submitted by you should be at least equal to the ones we are recommending. If lesser goals are proposed, you will have to explain how those goals and your plan represent your

best efforts to comply with the policy outlined in the contract clauses. There are a number of equally important aspects of the plan. You should familiarize yourself with the requirements set forth in the contract clauses relating to the subcontracting plan before submitting a proposal.

Your plan will be reviewed and scored in accordance with AFARS Appendix D to ensure it clearly represents your firm's ability to carry out the terms and conditions set forth in the contract clauses. A Subcontracting Plan with a score of less than 70 may not be accepted. It is recommended that you use the enclosed example as a guide to assist you in developing your own subcontracting plan/program. The example is intended to assist you in developing your own subcontracting plan/program. Delete the instructions shown in parenthesis or your small business program will not be approved. If discussions during the evaluation of your subcontracting program raises doubts as to your intentions or ability to comply with FAR clause 52.219-9 it could result in your disqualification for award.

Your plan must address how you will maximize subcontracting opportunities with the small business communities to be found within the project location. Demonstrated outreach efforts through conference attendance, use of ProNet, Corporate support of your Small Business Program Liaison Officer and Small Business Program must be addressed in your subcontracting plan.

Your Small Business Program Managers' attendance at DOD Regional Council Meetings for Small Business Education and Advocacy will be a contract requirement. **DOD Policy Guidance:** In accordance with the Small Business Act, it is the policy of the federal government to aid, assist, and counsel small business to ensure that a fair share of contracts are awarded to small business. Consistent with this, it is the policy of DOD to sponsor regional councils as one significant way to aid, assist, and counsel large business through education and advocacy *of its members who are charged with the responsibility of fulfilling this federal policy*. Therefore, be advised that the individual listed in paragraph 7 of the example will be required to attend these regional council meetings and that attendance must be addressed in your subcontracting plan. Contact at (425) 889-7318 for information relating to upcoming training opportunities. Your plan must be submitted with your price proposal.

Should you have any questions or need assistance in DEVELOPING YOUR SUBCONTRACTING PLAN please call the undersigned at (206) 764-6807. If you need TECHNICAL ASSISTANCE call Teresa Fullerton-Thormar at (206) 764-6696.

Enclosure

Sincerely,



Susan C. Price
Deputy for Small Business

NOTE: This is an example plan. You may use this example as a guide in developing your own small business program. Delete all the instructions (parenthesis), including this message, or your plan will be returned.

SMALL BUSINESS SUBCONTRACTING PLAN

DATE:

CONTRACTOR:

ADDRESS:

PHONE NO:

PROJECT TITLE:

SOLICITATION NO:

1. In accordance with the contract clauses at 52.219-8 and 52.219-9, (name of contractor) submits the following Subcontracting Plan for Small, Small Disadvantaged, and Women-owned Business Concerns.

2. Corresponding dollar values for percentages cited in para. 3 for the base period only:

- a. Total contract amount is \$ _____.
- b. Total dollars planned to be subcontracted (to all types of businesses): \$ _____.
- c. Total dollars planned to be subcontracted to small business concerns (including 2d, 2e, 2f, 2g, and 2h below):
\$ _____.
- d. Total dollars planned to be subcontracted to small disadvantaged business concerns: \$ _____.
- e. Total dollars planned to be subcontracted to small woman-owned business concerns: \$ _____.
- f. Total dollars planned to be subcontracted to HUBZone small business: \$ _____.
- g. Total dollars planned to be subcontracted to veteran-owned small business concerns \$ _____.
- h. Total dollars planned to be subcontracted to service-disabled veteran-owned small business concerns.
\$ _____.

3. The following percentage goals (expressed in terms of a percentage of total planned subcontracting dollars) are applicable to the contract awarded under the solicitation cited above.

a. Small Business Concerns (2c divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are small business concerns including 3c through 3e.

b. Small Disadvantaged Business Concerns (2g divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are small disadvantaged individuals. **(NOTE: SDB firms must be certified by SBA and meet the definition under clause 52.219-8(c)(3)).**

c. Small Woman-Owned Business Concerns (2h divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are small woman-owned businesses

d. Small HUBZone Business Concerns (2f divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are HUBZone small business contractors. (SEE the definition in contract clause 52.219-8(c) or use the internet: <http://www.sba.gov/hubzone/> for further information.)

e. Veteran-owned small business concerns (2d divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are veteran-owned small business.

f. Service-disabled veteran-owned small business concerns (2e divided by 2b): _____% of total planned subcontracting dollars under this contract will go to subcontractors who are service-disabled veteran-owned small business.

4. The principal items or areas we will subcontract under this contract are:

a. Of the items or areas stated in 4; the following are planned to be subcontracted to Small Businesses (LIST THE NAME AND RESPONSIBILITY OF FIRM):

b. Of the items or areas stated in 4.a; the following are planned to be subcontracted to Small Disadvantaged Businesses (LIST THE NAME AND RESPONSIBILITY OF FIRM):

c. Of the items or areas stated in 4.a; the following are planned to be subcontracted to Small Women-Owned Businesses (LIST THE NAME AND RESPONSIBILITY OF FIRM):

d. Of the items or areas stated in 4.a; the following are planned to be subcontracted to HUBZone small business concerns (LIST THE NAME AND RESPONSIBILITY OF FIRM):

e. Of the items or areas stated in 4.a; the following are planned to be subcontracted to Veteran-owned Small Business concerns (LIST THE NAME AND RESPONSIBILITY OF FIRM):

f. Of the items or areas stated in 4.a; the following are planned to be subcontracted to Service-disabled veteran-owned small business concerns (LIST THE NAME AND RESPONSIBILITY OF FIRM):

****NOTE: SEE LAST PAGE IF THIS SOLICITATION HAS OPTION YEARS OR PERIODS (DELETE THIS STATEMENT FROM YOUR PLAN)****

5. Provide a description of the method your firm used to develop the subcontracting goals in paragraph 3:

6. Indirect costs were () were not () used in establishing subcontracting goals. **If indirect costs are included in your goals, furnish a description of the method used to determine the proportionate share of indirect costs to be incurred with (i) small business concerns (ii) small disadvantaged business concerns (iii) women-owned small business concerns (iv) HUBZone small business concerns (v) Veteran-owned small business concerns and (vi) Service-disabled veteran-owned concerns **

7. The following individual will administer (name of contractor) Subcontracting Program:

(NOTE TO OFFERORS: The individual named here will be expected to perform and manage your plan and contract clause 52.219-9). Site Construction project managers may not be acceptable as your small business advocate that manages your Corporate Small Business Program).

Name: _____ Job Title: _____

Address and Telephone Number: _____

This individual's specific duties with regard to the conduct of our firm's Subcontracting Plan will include, but will not be limited to, the following:

a. Developing and maintaining bidders lists of small business, HUBZone small business, small disadvantaged business and women-owned small business concerns using sources such as the Small Business Administration's ProNet (<http://pro-net.sba.gov/>) Washington State Office of Minority and Women-owned Business Enterprises (<http://www.wsdot.wa.gov/omwbe/>) Minority Business Development Agency, US Department of Commerce, Local Minority Business Development Centers, Economic Development Centers, and National Center for American Indian Enterprise Development.

b. Assuring the inclusion of small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns in all solicitations for products or services which they are capable of providing; and ensuring that all solicitations are structured to permit the maximum possible participation by small business concerns, small disadvantaged business concerns, women-owned small business concerns,

HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns.

c. Establishing and maintaining records of all solicitations and subcontract awards to ensure that the members of the firm who review bidders proposals documents their reasons for selecting or not selecting a bid submitted by a small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns.

d. Preparing and submitting the Subcontracting Report for Individual Contracts (SF 294) and the Summary Subcontract Report (SF 295) in accordance with instructions provided, and coordinating and preparing for all compliance reviews by Federal agencies.

e. Attendance at DOD sponsored training programs in order to develop guidance and training to firm personnel on the policy of the federal government to aid, assist, and counsel small business under this and other government contracts.

f. Conducting or arranging for all other activities necessary to further the intent and attainment of the goals in the Plan to include motivational training of the firm's purchasing personnel, attendance at workshops, seminars and trade fairs conducted by or on behalf of small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns.

8. The following steps will be taken to ensure that small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns receive notice of and have an equitable opportunity to compete for intended awards of subcontracts and/or purchase orders for the products and/or services describe in paragraph 4 above:

a. Sources will be requested through SBA's ProNet system, business development organizations, minority and small business trade associations and at small, minority, veteran small business and women-owned small business procurement conferences; sources will be contacted; and bidding materials will be provided to all responding parties expressing an interest.

b. Internally, motivational training will be conducted to guide and encourage purchasing personnel; source lists and guides to small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns will be maintained and utilized by purchasing personnel while soliciting subcontracts and purchase orders; activities will be monitored to ensure sufficient time is allowed for interested bidders to prepare their proposals and to evaluate continuing compliance with the Subcontracting Plan.

9. [Name of contractor] agrees that the clause entitled "Utilization of Small Business Concerns" (Oct 2000) will be included in all subcontracts that offer further subcontracting opportunities. All subcontractors, except small business concerns, who receive subcontracts in excess of \$500,000 (\$1,000,000 in the case of construction) will be required to adopt a subcontracting plan that complies with the requirements of this clause. Such plans will be reviewed to assure that all minimum requirements of an acceptable subcontracting plan have been satisfied.

10. (Name of contractor) agrees to submit such periodic reports and cooperate in any studies or surveys as may be required by the Contracting agency or Small Business Administration in order to determine the extent of compliance by the offeror with the subcontracting plan and with the clause entitled "Utilization of Small Business Concerns" contained in the contract.

11. (Name of Contractor) agrees to maintain at least the following types of records to document compliance with the Subcontracting Plan:

a. The names of all organizations, agencies, and associations contacted for small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns along with records of attendance at conferences, seminars and trade fairs where additional sources were developed.

b. Source lists, guides, and other data identifying small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns.

c. Records on all subcontract solicitations resulting in an award of more than \$100,000 on a contract-by-contract basis, indicating (1) whether small business concerns were solicited, and if not, why not; (2) whether veteran-owned small business concerns were solicited, and if not, why not; (3) whether service-disabled veteran-owned small business concerns were solicited, and if not, why not; (4) whether HUBZone small business were solicited, and if not, why not; (5) whether small disadvantaged business concerns were solicited, and if not, why not; and (6) whether small women-owned business concerns were solicited, and if not, why not; and (7) reasons for the failure of solicited small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns to receive a subcontract award.

d. Records of all subcontract award data to include subcontractor's name and address, to be kept on a contract-by-contract basis.

e. Minutes of internal motivational and training meetings held for the guidance and encouragement of purchasing personnel, and records of all monitoring activities performed for compliance evaluation.

f. Copies of SF 294 and SF 295 showing date and place of filing and copies of all other reports or results of reviews conducted by the contracting agency or other interested agencies of the Federal government to monitor our compliance with this Subcontracting Plan.

12. (Name of Contractor) will submit a SF 295, Summary Subcontract Report, on Corps of Engineers projects only. The SF 295 shall be completed and distributed in accordance with the Corps of Engineers Supplemental Instructions. (Name of Contractor) will not report Corps of Engineers projects through any other Agency unless authorized by the Contracting Officer.

13. In closing, (Name of contractor) states that it will be the policy of (Name of contractor) to afford every practicable opportunity for small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns to participate in contracts awarded to (Name of contractor) by the Federal Government, to ensure that equitable opportunity is provided small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns to compete for award of subcontracts and purchase orders, and to diligently pursue the achievement of our goals of participation by small business concerns, small disadvantaged business concerns, women-owned small business concerns, HUBZone small business concerns, veteran-owned small business concerns and service-disabled veteran-owned small business concerns in the dollars available for subcontract/purchase order awards under this contract.

BY: _____

Signature and Title of CEO
Company Name

DATE: _____

NOTE: If this solicitation has options (or option periods) , the plan must contain separate goals for **each** option or option period (year). EXAMPLE:

	<u>Dollars</u>	<u>Percentage</u>
1. Optional Yr _____ total:	\$ _____	_____
2. Total to be subcontracted to all types of businesses:	\$ _____	_____
a. Subcontracted to Small Business (including b, c, d, e, and f below):	\$ _____	_____
b. Subcontracted to Small Disadvantaged Businesses:	\$ _____	_____
c. Subcontracted to Women-Owned Small Businesses:	\$ _____	_____
d. Subcontracted to HUBzone concerns	\$ _____	_____
e. Subcontracted to Veteran-owned Small Business:	\$ _____	_____
f. Subcontracted to Service-disabled Small Business	\$ _____	_____
1. Optional Yr _____ total:	\$ _____	_____
2. Total to be subcontracted to all types of businesses:	\$ _____	_____
a. Subcontracted to Small Business (including b, c, d, e, and f below):	\$ _____	_____
b. Subcontracted to Small Disadvantaged Businesses:	\$ _____	_____
c. Subcontracted to Women-Owned Small Businesses:	\$ _____	_____
d. Subcontracted to HUBzone concerns	\$ _____	_____
e. Subcontracted to Veteran-owned Small Business:	\$ _____	_____
f. Subcontracted to Service-disabled Small Business	\$ _____	_____

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Section 00100 - Bidding Schedule/Instructions to Bidders

SECTION 00100 TABLE OF CONTENT**Section 00100** - Bidding Schedule/Instructions to Bidders

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CLAUSES INCORPORATED BY FULL TEXT

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(a) Definitions.

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

___ TIN: _____

___ TIN has been applied for.

___ TIN is not required because:

___ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

___ Offeror is an agency or instrumentality of a foreign government;

___ Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

___ Sole proprietorship;

___ Partnership;

___ Corporate entity (not tax-exempt);

___ Corporate entity (tax-exempt);

___ Government entity (Federal, State, or local);

___ Foreign government;

___ International organization per 26 CFR 1.6049-4;

___ Other _____

(f) Common parent.

___ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

___ Name and TIN of common parent:

Name _____

TIN _____

(End of provision)

52.204-6 DATA UNIVERSAL NUMBERING SYSTEM (DUNS) NUMBER (JUN 99)

(a) The offeror shall enter, in the block with its name and address on the cover page of its offer, the annotation "DUNS" followed by the DUNS number that identifies the offeror's name and address exactly as stated in the offer.

(b) If the offeror does not have a DUNS number, it should contact Dun and Bradstreet directly to obtain one. A DUNS number will be provided immediately by telephone at no charge to the offeror. For information on obtaining a DUNS number, the offeror, if located within the United States, should call Dun and Bradstreet at 1-800-333-0505. The offeror should be prepared to provide the following information:

(1) Company name.

(2) Company address.

(3) Company telephone number.

(4) Line of business.

(5) Chief executive officer/key manager.

(6) Date the company was started.

(7) Number of people employed by the company.

(8) Company affiliation.

(c) Offerors located outside the United States may obtain the location and phone number of the local Dun and Bradstreet Information Services office from the Internet Home Page at <http://www.customerservice@dnb.com>. If an offeror is unable to locate a local service center, it may send an e-mail to Dun and Bradstreet at globalinfo@mail.dnb.com.

(End of provision)

52.211-2 AVAILABILITY OF SPECIFICATIONS LISTED IN THE DOD INDEX OF SPECIFICATIONS AND STANDARDS (DODISS) AND DESCRIPTIONS LISTED IN THE ACQUISITION MANAGEMENT SYSTEMS AND DATA REQUIREMENTS CONTROL LIST, DOD 5010.12-L (DEC 1999)

Copies of specifications, standards, and data item descriptions cited in this solicitation may be obtained--

(a) From the ASSIST database via the Internet at <http://assist.daps.mil>; or

(b) By submitting a request to the--Department of Defense Single Stock Point (DoDSSP), Building 4, Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Telephone (215) 697-2667/2179, Facsimile (215) 697-1462.

(End of provision)

Basis of Award (52.214-4022)

Notwithstanding any other provision of this invitation, the Government will award all base bid items as a minimum.

52.214-5000 APPARENT CLERICAL MISTAKES (MAR 1995)--EFARS

(a) For the purpose of initial evaluations of bids, the following will be utilized in the resolving arithmetic discrepancies found on the face of bidding schedule as submitted by the bidder:

- (1) Obviously misplaced decimal points will be corrected;
- (2) Discrepancy between unit price and extended price, the unit price will govern;
- (3) Apparent errors in extension of unit prices will be corrected;
- (4) Apparent errors in addition of lump-sum and extended prices will be corrected.

(b) For the purpose of bid evaluation, the government will proceed on the assumption that the bidder intends his bid to be evaluated on basis of the unit prices, the totals arrived at by resolution of arithmetic discrepancies as provided above and the bid will be so reflected on the abstract of bids.

X (c) These correction procedures shall not be used to resolve any ambiguity concerning which bid is low.

(End of statement)

52.215-1 INSTRUCTIONS TO OFFERORS--COMPETITIVE ACQUISITION (MAY 2001)

(a) Definitions. As used in this provision--

"Discussions" are negotiations that occur after establishment of the competitive range that may, at the Contracting Officer's discretion, result in the offeror being allowed to revise its proposal.

"In writing or written" means any worded or numbered expression which can be read, reproduced, and later communicated, and includes electronically transmitted and stored information.

“Proposal modification” is a change made to a proposal before the solicitation's closing date and time, or made in response to an amendment, or made to correct a mistake at any time before award.

“Proposal revision” is a change to a proposal made after the solicitation closing date, at the request of or as allowed by a Contracting Officer as the result of negotiations.

“Time”, if stated as a number of days, is calculated using calendar days, unless otherwise specified, and will include Saturdays, Sundays, and legal holidays. However, if the last day falls on a Saturday, Sunday, or legal holiday, then the period shall include the next working day.

(b) Amendments to solicitations. If this solicitation is amended, all terms and conditions that are not amended remain unchanged. Offerors shall acknowledge receipt of any amendment to this solicitation by the date and time specified in the amendment(s).

(c) Submission, modification, revision, and withdrawal of proposals. (1) Unless other methods (e.g., electronic commerce or facsimile) are permitted in the solicitation, proposals and modifications to proposals shall be submitted in paper media in sealed envelopes or packages (i) addressed to the office specified in the solicitation, and (ii) showing the time and date specified for receipt, the solicitation number, and the name and address of the offeror. Offerors using commercial carriers should ensure that the proposal is marked on the outermost wrapper with the information in paragraphs (c)(1)(i) and (c)(1)(ii) of this provision.

(2) The first page of the proposal must show--

(i) The solicitation number;

(ii) The name, address, and telephone and facsimile numbers of the offeror (and electronic address if available);

(iii) A statement specifying the extent of agreement with all terms, conditions, and provisions included in the solicitation and agreement to furnish any or all items upon which prices are offered at the price set opposite each item;

(iv) Names, titles, and telephone and facsimile numbers (and electronic addresses if available) of persons authorized to negotiate on the offeror's behalf with the Government in connection with this solicitation; and

(v) Name, title, and signature of person authorized to sign the proposal. Proposals signed by an agent shall be accompanied by evidence of that agent's authority, unless that evidence has been previously furnished to the issuing office.

(3) Submission, modification, or revision, of proposals.

(i) Offerors are responsible for submitting proposals, and any modifications, or revisions, so as to reach the Government office designated in the solicitation by the time specified in the solicitation. If no time is specified in the solicitation, the time for receipt is 4:30 p.m., local time, for the designated Government office on the date that proposal or revision is due.

(ii)(A) Any proposal, modification, or revision received at the Government office designated in the solicitation after the exact time specified for receipt of offers is “late” and will not be considered unless it is received before award is made, the Contracting Officer determines that accepting the late offer would not unduly delay the acquisition; and--

(1) If it was transmitted through an electronic commerce method authorized by the solicitation, it was received at the initial point of entry to the Government infrastructure not later than 5:00 p.m. one working day prior to the date specified for receipt of proposals; or

(2) There is acceptable evidence to establish that it was received at the Government installation designated for receipt of offers and was under the Government's control prior to the time set for receipt of offers; or

(3) It is the only proposal received.

(B) However, a late modification of an otherwise successful proposal that makes its terms more favorable to the Government, will be considered at any time it is received and may be accepted.

(iii) Acceptable evidence to establish the time of receipt at the Government installation includes the time/date stamp of that installation on the proposal wrapper, other documentary evidence of receipt maintained by the installation, or oral testimony or statements of Government personnel.

(iv) If an emergency or unanticipated event interrupts normal Government processes so that proposals cannot be received at the office designated for receipt of proposals by the exact time specified in the solicitation, and urgent Government requirements preclude amendment of the solicitation, the time specified for receipt of proposals will be deemed to be extended to the same time of day specified in the solicitation on the first work day on which normal Government processes resume.

(v) Proposals may be withdrawn by written notice received at any time before award. Oral proposals in response to oral solicitations may be withdrawn orally. If the solicitation authorizes facsimile proposals, proposals may be withdrawn via facsimile received at any time before award, subject to the conditions specified in the provision at 52.215-5, Facsimile Proposals. Proposals may be withdrawn in person by an offeror or an authorized representative, if the identity of the person requesting withdrawal is established and the person signs a receipt for the proposal before award.

(4) Unless otherwise specified in the solicitation, the offeror may propose to provide any item or combination of items.

(5) Offerors shall submit proposals in response to this solicitation in English, unless otherwise permitted by the solicitation, and in U.S. dollars, unless the provision at FAR 52.225-17, Evaluation of Foreign Currency Offers, is included in the solicitation.

(6) Offerors may submit modifications to their proposals at any time before the solicitation closing date and time, and may submit modifications in response to an amendment, or to correct a mistake at any time before award.

(7) Offerors may submit revised proposals only if requested or allowed by the Contracting Officer.

(8) Proposals may be withdrawn at any time before award. Withdrawals are effective upon receipt of notice by the Contracting Officer.

(d) Offer expiration date. Proposals in response to this solicitation will be valid for the number of days specified on the solicitation cover sheet (unless a different period is proposed by the offeror).

(e) Restriction on disclosure and use of data. Offerors that include in their proposals data that they do not want disclosed to the public for any purpose, or used by the Government except for evaluation purposes, shall--

(1) Mark the title page with the following legend: This proposal includes data that shall not be disclosed outside the Government and shall not be duplicated, used, or disclosed--in whole or in part--for any purpose other than to evaluate this proposal. If, however, a contract is awarded to this offeror as a result of--or in connection with-- the submission of this data, the Government shall have the right to duplicate, use, or disclose the data to the extent provided in the resulting contract. This restriction does not limit the Government's right to use information contained in this data if it is obtained from another source without restriction. The data subject to this restriction are contained

in sheets [insert numbers or other identification of sheets]; and

(2) Mark each sheet of data it wishes to restrict with the following legend: Use or disclosure of data contained on this sheet is subject to the restriction on the title page of this proposal.

(f) Contract award. (1) The Government intends to award a contract or contracts resulting from this solicitation to the responsible offeror(s) whose proposal(s) represents the best value after evaluation in accordance with the factors and subfactors in the solicitation.

(2) The Government may reject any or all proposals if such action is in the Government's interest.

(3) The Government may waive informalities and minor irregularities in proposals received.

(4) The Government intends to evaluate proposals and award a contract without discussions with offerors (except clarifications as described in FAR 15.306(a)). Therefore, the offeror's initial proposal should contain the offeror's best terms from a cost or price and technical standpoint. The Government reserves the right to conduct discussions if the Contracting Officer later determines them to be necessary. If the Contracting Officer determines that the number of proposals that would otherwise be in the competitive range exceeds the number at which an efficient competition can be conducted, the Contracting Officer may limit the number of proposals in the competitive range to the greatest number that will permit an efficient competition among the most highly rated proposals.

(5) The Government reserves the right to make an award on any item for a quantity less than the quantity offered, at the unit cost or prices offered, unless the offeror specifies otherwise in the proposal.

(6) The Government reserves the right to make multiple awards if, after considering the additional administrative costs, it is in the Government's best interest to do so.

(7) Exchanges with offerors after receipt of a proposal do not constitute a rejection or counteroffer by the Government.

(8) The Government may determine that a proposal is unacceptable if the prices proposed are materially unbalanced between line items or subline items. Unbalanced pricing exists when, despite an acceptable total evaluated price, the price of one or more contract line items is significantly overstated or understated as indicated by the application of cost or price analysis techniques. A proposal may be rejected if the Contracting Officer determines that the lack of balance poses an unacceptable risk to the Government.

(9) If a cost realism analysis is performed, cost realism may be considered by the source selection authority in evaluating performance or schedule risk.

(10) A written award or acceptance of proposal mailed or otherwise furnished to the successful offeror within the time specified in the proposal shall result in a binding contract without further action by either party.

(11) The Government may disclose the following information in postaward debriefings to other offerors:

(i) The overall evaluated cost or price and technical rating of the successful offeror;

(ii) The overall ranking of all offerors, when any ranking was developed by the agency during source selection;

(iii) A summary of the rationale for award; and

(iv) For acquisitions of commercial items, the make and model of the item to be delivered by the successful offeror.

(End of provision)

52.216-1 TYPE OF CONTRACT (APR 1984)

The Government contemplates award of a Firm Fixed Price contract resulting from this solicitation.

(End of clause)

52.217-5 EVALUATION OF OPTIONS (JUL 1990)

(a) Except when it is determined in accordance with FAR 17.206(b) not to be in the Government's best interests, the Government will evaluate offers for award purposes by adding the total price for all options to the total price for the basic requirement. Evaluation of options will not obligate the Government to exercise the option(s).

(b) The Government may reject an offer as nonresponsive if it is materially unbalanced as to prices for the basic requirement and the option quantities. An offer is unbalanced when it is based on prices significantly less than cost for some work and prices which are significantly overstated for other work.

(End of provision)

52.225-12 NOTICE OF BUY AMERICAN ACT REQUIREMENT-- CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (MAY 2002)

(a) Definitions. Construction material, designated country construction material, domestic construction material, foreign construction material, and NAFTA country construction material, as used in this provision, are defined in the clause of this solicitation entitled "Buy American Act --Construction Materials under Trade Agreements" (Federal Acquisition Regulation (FAR) clause 52.225-11).

(b) Requests for determination of inapplicability. An offeror requesting a determination regarding the inapplicability of the Buy American Act should submit the request to the Contracting Officer in time to allow a determination before submission of offers. The offeror shall include the information and applicable supporting data required by paragraphs (c) and (d) of FAR clause 52.225-11 in the request. If an offeror has not requested a determination regarding the inapplicability of the Buy American Act before submitting its offer, or has not received a response to a previous request, the offeror shall include the information and supporting data in the offer.

(c) Evaluation of offers. (1) The Government will evaluate an offer requesting exception to the requirements of the Buy American Act, based on claimed unreasonable cost of domestic construction materials, by adding to the offered price the appropriate percentage of the cost of such foreign construction material, as specified in paragraph (b)(4)(i) of FAR clause 52.225-11.

(2) If evaluation results in a tie between an offeror that requested the substitution of foreign construction material based on unreasonable cost and an offeror that did not request an exception, the Contracting Officer will award to the offeror that did not request an exception based on unreasonable cost.

(d) Alternate offers. (1) When an offer includes foreign construction material, other than designated country or NAFTA country construction material, that is not listed by the Government in this solicitation in paragraph (b)(3) of FAR clause 52.225-11, the offeror also may submit an alternate offer based on use of equivalent domestic, designated country, or NAFTA country construction material.

(2) If an alternate offer is submitted, the offeror shall submit a separate Standard Form 1442 for the alternate offer, and a separate price comparison table prepared in accordance with paragraphs (c) and (d) of FAR clause 52.225-11 for the offer that is based on the use of any foreign construction material for which the Government has not yet determined an exception applies.

(3) If the Government determines that a particular exception requested in accordance with paragraph (c) of FAR clause 52.225-11 does not apply, the Government will evaluate only those offers based on use of the equivalent domestic, designated country, or NAFTA country construction material, and the offeror shall be required to furnish such domestic, designated country, or NAFTA country construction material. An offer based on use of the foreign construction material for which an exception was requested--

(i) Will be rejected as nonresponsive if this acquisition is conducted by sealed bidding; or

(ii) May be accepted if revised during negotiations.

(End of provision)

52.228-1 BID GUARANTEE (SEP 1996)

(a) Failure to furnish a bid guarantee in the proper form and amount, by the time set for opening of bids, may be cause for rejection of the bid.

(b) The bidder shall furnish a bid guarantee in the form of a firm commitment, e.g., bid bond supported by good and sufficient surety or sureties acceptable to the Government, postal money order, certified check, cashier's check, irrevocable letter of credit, or, under Treasury Department regulations, certain bonds or notes of the United States. The Contracting Officer will return bid guarantees, other than bid bonds, (1) to unsuccessful bidders as soon as practicable after the opening of bids, and (2) to the successful bidder upon execution of contractual documents and bonds (including any necessary coinsurance or reinsurance agreements), as required by the bid as accepted.-

(c) The amount of the bid guarantee shall be 20 percent of the bid price or \$ 3,000,000, whichever is less.-

(d) If the successful bidder, upon acceptance of its bid by the Government within the period specified for acceptance, fails to execute all contractual documents or furnish executed bond(s) within 10 days after receipt of the forms by the bidder, the Contracting Officer may terminate the contract for default.-

(e) In the event the contract is terminated for default, the bidder is liable for any cost of acquiring the work that exceeds the amount of its bid, and the bid guarantee is available to offset the difference.

(End of clause)

INFORMATION REGARDING PERFORMANCE AND PAYMENT BONDS (FAR 28.102) (52.228-4001) FEB 2001

Within 10 days after the prescribed forms are presented to the bidder to whom award is made, unless a shorter time is prescribed in the contract, two bonds, namely a performance bond (Standard Form 25) and a payment bond (Standard Form 25A), shall be executed and furnished to the Government, each with good and sufficient surety or sureties acceptable to the Government. The penal sums of such bonds shall be as follows:

- (1) Performance Bond. The penal sum of the performance bond shall equal one hundred percent (100%) of the contract price.
- (2) Payment Bond. The penal sum of the payment bond shall equal one hundred percent (100%) of the contract price.

Any bonds furnished must be furnished by the Contractor to the Government prior to commencement of contract performance.

INDIVIDUAL SURETIES (52.228-4003) DEC 1999

As prescribed in FAR 28.203, individual sureties are acceptable for all types of bonds except position schedule bonds.

One individual surety is adequate support for a bond, provided the unencumbered value of the assets pledged by that individual surety equal or exceed the amount of the bond. An offeror may submit up to three individual sureties for each bond, in which case the pledged assets, when combined, must equal or exceed the penal amount of the bond. Each individual surety must accept both joint and several liability to the extent of the penal amount of the bond.

An individual surety may be accepted only if a security interest in acceptable assets is provided to the Government by the individual surety. THE SECURITY INTEREST SHALL BE FURNISHED WITH THE BOND.

Acceptable assets include:

- (a) Cash, or certificates of deposit, or other cash equivalents with a federally insured financial institution;
- (b) United States Government securities at market value.
- (c) Stocks and bonds actively traded on a national U.S. security exchange with certificates issued in the name of the individual surety. (See FAR 28.203-2(b)(3) for list of acceptable exchanges).
- (d) Real property owned in fee simple by the surety without any form of concurrent ownership, except as provided in FAR 28.203-2(c) (3)(iii), and located within the 50 United States, its territories, or possessions. These assets will be accepted at 100% of the most current tax assessment value (exclusive of encumbrances) or 75% of the properties' unencumbered market value provided a current appraisal is furnished. (See clause entitled "Pledges of Assets").
- (e) Irrevocable letters of credit (ILC) issued by a federally insured financial institution in the name of the contracting agency and which identify the agency and solicitation or contract number for which the ILC is provided.

Unacceptable assets include but are not limited to:

- (a) Notes or accounts receivable;
- (b) Foreign securities;
- (c) Real property as follows:
 - (1) Real property located outside the United States, its territories, or possessions.
 - (2) Real property which is a principal residence of the surety.
 - (3) Real property owned concurrently regardless of the form of co-tenancy (including joint tenancy, tenancy by the entirety, and tenancy in common) except where all co-tenants agree to act jointly.
 - (4) Life estates, leasehold estates, or future interests in real property.
- (d) Personal property other than that listed as acceptable assets above (e.g., jewelry, furs, antiques);
- (e) Stocks and bonds of the individual surety in a controlled, affiliated, or closely held concern of the offeror/contractor;
- (f) corporate assets (e.g., plant and equipment);
- (g) Speculative assets (e.g., mineral rights);
- (h) Letters of credit, except as provided above.

In order for the Contracting Officer to determine the acceptability of individuals proposed as sureties, all bidders/offerors who submit bonds which are executed by individual sureties shall furnish with the bonds:

- (a) SF28, Affidavit of Individual Surety,

(b) Security interest provided to the Government for all pledged assets (See clause entitled "Pledge of Assets") and

(c) A current list of all other bonds (including Bid Bonds) on which each individual surety is a surety and bonds for which the individual is requesting to be a surety, together with a statement as to the percent of completion of these bonded jobs. The list will include Contract or Solicitation Numbers, the name, address and telephone number of the contracting office, the type of bond (bid, performance or payment), and the amount of each original obligation. (Note: Performance and Payment bonds must be listed separately.)

Failure to furnish this information may result in non-approval of the surety and a determination of nonresponsibility.

52.232-38 SUBMISSION OF ELECTRONIC FUNDS TRANSFER INFORMATION WITH OFFER (MAY 1999)

The offeror shall provide, with its offer, the following information that is required to make payment by electronic funds transfer (EFT) under any contract that results from this solicitation. This submission satisfies the requirement to provide EFT information under paragraphs (b)(1) and (j) of the clause at 52.232-34, Payment by Electronic Funds Transfer--Other than Central Contractor Registration.

- (1) The solicitation number (or other procurement identification number).
- (2) The offeror's name and remittance address, as stated in the offer.
- (3) The signature (manual or electronic, as appropriate), title, and telephone number of the offeror's official authorized to provide this information.
- (4) The name, address, and 9-digit Routing Transit Number of the offeror's financial agent.
- (5) The offeror's account number and the type of account (checking, savings, or lockbox).
- (6) If applicable, the Fedwire Transfer System telegraphic abbreviation of the offeror's financial agent.
- (7) If applicable, the offeror shall also provide the name, address, telegraphic abbreviation, and 9-digit Routing Transit Number of the correspondent financial institution receiving the wire transfer payment if the offeror's financial agent is not directly on-line to the Fedwire and, therefore, not the receiver of the wire transfer payment.

(End of provision)

52.233-2 SERVICE OF PROTEST (AUG 1996)

(a) Protests, as defined in section 33.101 of the Federal Acquisition Regulation, that are filed directly with an agency, and copies of any protests that are filed with the General Accounting Office (GAO), shall be served on the Contracting Officer (addressed as follows) by obtaining written and dated acknowledgment of receipt from Kent Paul, Chief, Contracting Division, CENWS-CT-CB, Post Office Box 3755, Seattle, Washington 98124-3755.

(b) The copy of any protest shall be received in the office designated above within one day of filing a protest with the GAO.

(End of provision)

MAGNITUDE OF CONSTRUCTION (FAR 36.204) (52. 236-4902) DEC 1999

- (a) Amount of Construction for this solicitation is in the range of \$25,000,000 to \$100,000,000.

252.204-7001 COMMERCIAL AND GOVERNMENT ENTITY (CAGE) CODE REPORTING (AUG 1999)

(a) The offeror is requested to enter its CAGE code on its offer in the block with its name and address. The CAGE code entered must be for that name and address. Enter "CAGE" before the number.

(b) If the offeror does not have a CAGE code, it may ask the Contracting Officer to request one from the Defense Logistics Information Service (DLIS). The Contracting Officer will--

(1) Ask the Contractor to complete section B of a DD Form 2051, Request for Assignment of a Commercial and Government Entity (CAGE) Code;

(2) Complete section A and forward the form to DLIS; and

(3) Notify the Contractor of its assigned CAGE code.

(c) Do not delay submission of the offer pending receipt of a CAGE code.

(End of provision)

252.204-7004 REQUIRED CENTRAL CONTRACTOR REGISTRATION (NOV 2001)

(a) Definitions.

As used in this clause--

(1) Central Contractor Registration (CCR) database means the primary DoD repository for contractor information required for the conduct of business with DoD.

(2) Data Universal Numbering System (DUNS) number means the 9-digit number assigned by Dun and Bradstreet Information Services to identify unique business entities.

(3) Data Universal Numbering System +4 (DUNS+4) number means the DUNS number assigned by Dun and Bradstreet plus a 4-digit suffix that may be assigned by a parent (controlling) business concern. This 4-digit suffix may be assigned at the discretion of the parent business concern for such purposes as identifying subunits or affiliates of the parent business concern.

(4) Registered in the CCR database means that all mandatory information, including the DUNS number or the DUNS+4 number, if applicable, and the corresponding Commercial and Government Entity (CAGE) code, is in the CCR database; the DUNS number and the CAGE code have been validated; and all edits have been successfully completed.

(b)(1) By submission of an offer, the offeror acknowledges the requirement that a prospective awardee must be registered in the CCR database prior to award, during performance, and through final payment of any contract resulting from this solicitation, except for awards to foreign vendors for work to be performed outside the United States.

(2) The offeror shall provide its DUNS or, if applicable, its DUNS+4 number with its offer, which will be used by the Contracting Officer to verify that the offeror is registered in the CCR database.

(3) Lack of registration in the CCR database will make an offeror ineligible for award.

(4) DoD has established a goal of registering an applicant in the CCR database within 48 hours after receipt of a complete and accurate application via the Internet. However, registration of an applicant submitting an application through a method other than the Internet may take up to 30 days. Therefore, offerors that are not registered should consider applying for registration immediately upon receipt of this solicitation.

(c) The Contractor is responsible for the accuracy and completeness of the data within the CCR, and for any liability resulting from the Government's reliance on inaccurate or incomplete data. To remain registered in the CCR database after the initial registration, the Contractor is required to confirm on an annual basis that its information in the CCR database is accurate and complete.

(d) Offerors and contractors may obtain information on registration and annual confirmation requirements by calling 1-888-227-2423, or via the Internet at <http://www.ccr.gov>.

(End of clause)

SECTION 00110

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SECTION 00110 PROPOSAL SUBMISSION AND EVALUATION

1. INTRODUCTION.

1.1. Your firm is invited to submit a proposal in response to Request for Proposal No. **DACA67-03-R-0205** entitled " **FY03 Whole Barracks Renewal, Fort Lewis, Washington.**" Prospective offerors are required to prepare and submit proposals that will be evaluated in accordance with this section of the solicitation. In accordance with Federal Acquisition Regulations (FAR), Part 15.101-2, proposals will be evaluated using the lowest price technically acceptable source selection process. The evaluation process will be to first determine those proposals that are technically acceptable and then from those proposals determine which firm is the lowest price. The firm offering the **lowest price technically acceptable offer will be awarded the contract.**

1.2. Project Description

FY03 Whole Barracks Renewal at Fort Lewis, Washington. Construct six three-story barracks and two soldier community buildings (approx. 17,000 sqm) to house a total of 500 soldiers, with living/sleeping rooms and semi-private baths; medium company operations facilities (approx. 3,092 sqm); a large battalion headquarters with a classroom (approx. 1,452 sqm); and lawn mower storage facilities (approx. 50 sqm); and all associated site work and utilities. Construction includes structural steel frame, steel stud/masonry veneer exterior walls, steel stud and gypsum board interior partitions. Electrical systems include security, fire alarms, and telecommunications. Special construction includes arms vaults and documents vaults. Mechanical work for the barracks and soldier community buildings includes a central ventilation and exhaust system utilizing air-to-air heat exchangers that provide room ventilation on a continuous basis. Provide landscaping to include irrigated lawn areas, dry land seeded areas, and a troop training area, as well as trees and shrubs throughout the site. Provide water distribution line, fire protection line, sanitary sewer line and gas distribution line. Provide new roadway, and parking areas, including base, sub base and surface. Site preparation includes demolition of some existing site improvements.

2. EVALUATION FACTORS.

2.1. Technical Evaluation Factors.

2.1.1. The technical evaluation factors identified below will be evaluated on an ACCEPTABLE/NON-ACCEPTABLE basis only:

2.1.1.1. Relevant Experience of the Prime Firm

2.1.1.2. Qualifications of Key Team Members

2.1.1.3. Past Performance

2.2. Basis of the source selection evaluation - This Section establishes the method to be implemented with regard to the evaluation of the proposals. Evaluation is to be based exclusively on the merits and contents of the proposal and any subsequent discussions required. Offerors not meeting the minimum requirements of all technical evaluation factors shall be determined to be **NON-ACCEPTABLE** and will not be considered for award. Technical Proposals will be evaluated on an **ACCEPTABLE** or **NON-ACCEPTABLE** basis only. Proposals must set forth full, accurate, and complete information as required by this RFP. Absence of information will be deemed as if no support for that factor was provided. Award will be made to the lowest price technically acceptable offeror.

2.2.1. Technical Evaluation Ratings - Definitions

2.2.1.1. Acceptable: An acceptable rating indicates that the offeror has provided sufficient information to meet the minimum qualifications/standards described in the technical evaluation factor.

2.2.1.2. Non-Acceptable: A non-acceptable rating indicates that the offeror has not provided sufficient information to meet the minimum qualifications/standards described in the technical evaluation factor.

3. GENERAL SUBMITTAL REQUIREMENTS.

3.1. Proposals shall be submitted in two parts: (a) **technical proposal**, and (b) **price proposal**. Each shall be submitted in a separate envelope or package with the type of proposal (i.e., technical or price) clearly printed on the outside of the envelope or package. The maximum number of pages in the technical proposal should not exceed 60 one-sided pages with a font size no smaller than 10 point. Offerors submitting proposals should limit submission to data essential for evaluation of proposals so that a minimum of time and moneys are expended in preparing information required by the RFP. Proposals are to be on 8 ½ x 11-inch paper, to the maximum extent practicable, and submitted in standard letter (8½ x 11-inch) hardback loose-leaf binders. Contents of binders shall be tabbed and labeled to afford easy identification from the proposal Table of Contents. No material shall be incorporated by reference or reiteration of the RFP. Any such material will not be considered for evaluation. It shall be presented in a manner, which allows it to "STAND ALONE" without need for evaluators to reference other documents. Table of Contents, Index Tabs, and Photographs **will not** be considered a page. Unnecessarily elaborate brochures or other presentation materials beyond those sufficient to present complete and effective responses are not desired and may be construed as an indication of the proposer's lack of cost-consciousness. Penalty for making false statements in proposals is prescribed in 18 U.S.C. 1001.

4. MINIMUM SUBMITTAL REQUIREMENTS

4.1. Relevant experience of the prime firm. The Offeror shall submit descriptions of four (4) projects demonstrating relevant experience. Relevant experience is defined as experience constructing facilities similar in scope, cost, and complexity to the project in this solicitation. Only those projects for which the Offeror was the Prime Contractor and which were completed within the past seven (7) years should be submitted. The projects selected should clearly demonstrate the construction capabilities of the Offeror, such as military barracks, college dormitories, apartment complexes, multi story office buildings or other similar type structures, for either civilian or military use. As a minimum, for each project listed, provide:

- 1) Project title and location
- 2) Dollar value of construction
- 3) Construction period (month/year start to month/year end)
- 4) Description of the project scope of work
- 5) Brief description of how the project is relevant, and meets the requirements of this RFP project.
- 6) Current primary point of contact for the customer (name, relationship to project, agency/firm affiliation, city and state, phone number).

4.2. Qualifications of key team members. The Offeror should submit the names and résumés for key construction personnel that will be assigned to this project. In addition, the Offeror will provide a concise summary of the duties and responsibilities for each of the individuals proposed, which clearly indicates separate duties and responsibilities for each of the following positions; individuals; Project Superintendent, Project Manager, and Contractor Quality Control System Manager. The proposal should clearly present the separate credentials for each position of each person performing the duties of the position to which they are identified. Resumes should include examples of project experience, not to exceed three (3) examples, and educational qualifications, if applicable. It is expected that the key individuals in your proposal will be the individuals who perform work under the contract. **The contracting officer must approve substitute personnel.**

Resumes should be no more than two (2) pages per individual and submitted in a format similar to the one below: As a minimum, this factor should include data on the following personnel:

4.2.1. Project Superintendent: The Project Superintendent shall have no less than 7 years of experience on at least three (3) projects as a project superintendent on construction projects of similar scope, cost and complexity. The experience must demonstrate construction knowledge, the ability to manage large subcontracting teams, complex projects (i.e. square meters of floor space, types of mechanical systems, environmental controls, etc.), and multiple buildings, and be consistent with the type of construction required in this solicitation.

4.2.2. Project Manager: The Project Manager shall have a baccalaureate degree in a relevant field such as engineering, architecture or construction management and experience managing a minimum of three (3) projects that demonstrates the ability to manage construction projects similar in scope, cost and complexity to the project in this solicitation **or** a person in the construction field with a minimum of 10 years as a project manager on projects of the same scope, cost and complexity to the project in this solicitation.

4.2.3. CQC System Manager: The CQC (Contractor Quality Control) System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of five (5) years construction experience on construction similar to this solicitation **or** a construction person with a minimum of 10 years in related work. (See Section 01451 for complete requirements for the CQC System Manager.)

4.2.4. Resume Format For Key Team Members. Resumes should be no more than two (2) pages per individual and submitted in a format similar to the one below:

<p style="text-align: center;"><u>RESUME FORMAT</u></p> <p><i>Name and Title</i></p> <ol style="list-style-type: none"> <i>1. Proposed Duties/Functions for this project</i> <i>2. Firm Affiliation and Years Affiliated</i> <i>3. Years of Experience performing duties/functions as proposed for this project.</i> <i>4. Education – School attended, Degree, Certification, Year, and Specialization</i> <i>5. List Active Registrations (Professional or Technical Licenses/Certifications)</i> <i>6. Describe Specific Qualifications for this project</i> <i>7. List Projects worked on to Include</i> <p style="text-align: center;"><i>Project Title & Location</i></p> <p>Scope, Size and Complexity</p> <p style="text-align: center;"><i>Duties/Functions</i></p> <p style="text-align: center;"><i>Date of project</i></p> <ol style="list-style-type: none"> <i>8. Demonstrate how each project submitted is relevant to the project to be constructed under this solicitation.</i>
--

4.3. Past Performance of the Prime. Past performance of the prime contractor will be evaluated using the CCASS database. All performance ratings for the past 7 years shall be considered. If an offeror does not have past performance available in CCASS or wishes to augment the CCASS system ratings, the offerors may ask customers to submit the Customer Satisfaction Survey found at the end of this section. For each project constructed for Private Industry, provide a completed Customer Satisfaction Survey for each applicable project within the last 7 years. All Customer Satisfaction Surveys must be submitted to the Government from the

customer or agency that is providing the information. Further instructions are found at the top of the Customer Satisfaction Survey. It is requested that only relevant projects be included. A relevant project is one of the same scope, cost and complexity as this solicitation. Should the offerors want to review the CCASS ratings contained in the Corps of Engineers CCASS Database, they may request the information by fax on company letterhead at the following telefax number: (503) 808-4596. The Government reserves the right to contact the evaluator on previous Government or Private Sector work to verify the Offeror's construction experience. In the case of an offeror without a record of past performance or for whom information on past performance is not available, the offeror **may not be evaluated as favorable or unfavorable** on past performance (See FAR 15.305(a)(2)(iv)). An overall rating of satisfactory or above on CCASS performance evaluations and an overall acceptable rating on Customer Satisfaction Surveys will be given an acceptable rating.

4.3.1. Offeror Submitted Surveys. Surveys submitted directly by the offeror may not be considered. Please ensure envelopes containing surveys being submitted to this office do not contain the offeror's return address.

4.3.2 As a maximum, no more than five (5) customer satisfaction surveys will be considered for the prime firm (i.e., the firm signing the Standard Form 1442, Solicitation, Offer and Award) for work not listed (i.e. civilian projects) in the Government CCASS system.

5. PROPOSAL CONTENTS/FORMAT.

5.1. Technical Proposal Format. As a minimum, each copy of the technical proposal should contain the information and follow the general format specified below. Pages should be numbered from beginning to end, without repeating for new sections.

5.2. Technical Proposal Format- Five (5) sets required, original plus four (4) copies

TECHNICAL PROPOSAL FORMAT

1. Technical Proposal Cover Letter, to include:

- a. Solicitation Number***
- b. Name, address, and telephone and facsimile numbers of the Offeror (and electronic address, if available)***
- c. A statement specifying the extent of agreement with all terms, conditions, and provisions included in the solicitation and agreement to furnish any or all items upon which prices are offered at the price set opposite each item***
- d. Name, titles, and telephone and facsimile numbers (and electronic addresses if available) of persons authorized to negotiate on the Offeror's behalf with the Government in connection with this solicitation***
- e. Name, title, and signature of person authorized to sign the proposal. Proposals signed by an agent shall be accompanied by evidence of that agent's authority, unless that evidence has been previously furnished to the issuing office.***
- f. Table of Contents. List all sections for the technical proposal. Any future amendments, additions and/or revisions to proposal shall include updated Table of Contents for each set.***

2. *Relevant Experience data*
3. *Qualifications of key team members.*
4. *Past Performance data.*

5.3. Price Proposal Format. The price proposal shall be submitted in an **ORIGINAL plus 1 copy** and must be signed by an official authorized to bind your firm. Note that Standard Form 1442, Block 13D, provides the number of calendar days after the date of the offer for which the proposal is firm. The price proposal, to be submitted at the same time as the technical proposal, should include:

5.4 Price Proposal - Original and one (1) copy

SF 1442, Solicitation, Offer and Award and Award and Corporate certificate
Acknowledge all amendments by number and date in Block 19 on SF 1442 BACK
Pricing Schedule
Section 00600, Representation, Certifications and Other Statements of Offerors and Pre-award Information
Banking and Bonding information
Bid Bond
Subcontracting plan (large business only)

5.5. Additional Instructions.

5.5.1. Small Business Subcontracting - Plan Offerors must submit pricing for all items in the Schedule. In addition, **large businesses are required to submit a subcontracting plan** (See FAR Clause 52.219-9 Alt II, Small Business Subcontracting Plan, Jan 2002) with initial price proposals. Award will not be made under this solicitation without an approved subcontracting plan. (See the "Notice to Large Business Firms" located in the front of this solicitation.) Provide the name, point of contact, phone number, and address for the bank and bonding company of the firm signing the SF 1442.

5.5.2. Bid Bonds - Bid Bonds must be accompanied by a Power of Attorney containing an original signature from the surety, which must be affixed to the Power of Attorney after the Power of Attorney has been generated. Computer generated and signed Power's of Attorney will only be accepted if accompanied by an original certification from a current officer of the surety attesting to its authenticity and continuing validity.

6. PROPOSAL EVALUATIONS AND AWARD. A firm fixed-price contract will be awarded to one firm submitting the proposal that:

6.1. Conforms to this request for proposals (RFP),

6.2. Is the technically acceptable, lowest price offer, and

6.3. Is determined to be in the best interest of the Government.

6.4. To be considered for award, proposals shall conform to the terms and conditions contained in the RFP. No proposal shall be accepted that does not address all factors specified in this solicitation or which includes stipulations or qualifying conditions.

6.5. Price. Price will be evaluated for reasonableness and to assess the offeror's understanding of the contract requirements and any risk inherent in the offeror's approach. Financial capacity and bonding ability will be checked.

6.6. Award. It is the intent of the Government to make award based upon the lowest price technically acceptable initial offer, without further discussions or additional information. Therefore, proposals shall be submitted initially on the most favorable terms from a price and technical standpoint. Do not assume you will be afforded the opportunity to clarify, discuss or revise your proposal. If award is not made on initial offers, discussion will be conducted as described below.

6.7. Competitive Range. (FAR 15.306(c))

6.7.1. Competitive Range. After initial evaluation of proposals, if the Contracting Officer determines that discussions are required, the Contracting Officer will establish a competitive range comprised of the technically acceptable proposals. Discussions will be held with firms in the competitive range.

6.7.2. Discussions. Should it be necessary for discussions, the Government will conduct written discussions with only those offerors determined to be technically acceptable. If all proposals are determined to be non-acceptable, at the Contracting Officer's discretion, all firms may be requested to participate in discussions. As a result of discussions, offerors may make revisions to their initial offers. Discussions will culminate in a request for Final Proposal Revision, the date and time of which will be common to all offerors.

7. DEBRIEFINGS.

7.1 Pre-award. Offerors excluded from the competition before award will receive a notice and may request a debriefing before award by submitting a written request for a debriefing to the Contracting Officer within three (3) days after receipt of the notice of exclusion from the competition.

7.2 Post-award. Unsuccessful Offerors shall request post-award debriefing within three (3) days after the date on which the offeror received notification of contract award. Point-by-point comparisons with other offerors' proposals will not be made, and debriefings will not reveal any information that is not releasable under the Freedom of Information Act.

8. PROPOSAL EXPENSES AND PRECONTRACT COSTS PROPOSAL EXPENSES AND PRECONTRACT COSTS: This RFP does not commit the Government to pay costs incurred in preparation and submission of the initial and any subsequent proposals or any other costs incurred prior to execution of a formal contract.

**END OF SECTION 00110 –
SEE CUSTOMER SATISFACTION SURVEY
FOLLOWING THIS PAGE**

CUSTOMER SATISFACTION SURVEY
RFP # DACA67-03-R-0205, FY03 Whole Barracks Renewal, Ft. Lewis, Washington

SECTION 1 -- TO BE COMPLETED BY THE OFFEROR AND PROVIDED TO THE CUSTOMER REFERENCED

Name of Firm Being Evaluated: _____

Project Title & Location: _____

Project Dollar Value: _____

Year Completed: _____ **Project Manager:** _____

SECTION 2 - TO BE COMPLETED BY THE CUSTOMER REFERENCED AND MAILED, HAND-DELIVERED, E-MAILED OR FAXED DIRECTLY TO:

U.S. Army Corps of Engineers, Seattle District
 Attn: CENWS-CT-CB-MU (Thomas R. DeGonia)
 P.O. Box 3755
 Seattle, WA 98124-3755
 E- Mail: Thomas.R.DeGonia@nws02.usace.army.mil

FAX: (206) 764-6817
Street Address:
 4735 E. Marginal Way S.
 Seattle WA 98134-2329

OVERVIEW: The firm shown above is submitting a proposal on a Seattle District Corps of Engineers project and provided your name as a customer reference. Part of our evaluation process requires information on the firm's past performance. Your participation is important to us and responses are required by the date proposals are due 20 February 2003 for inclusion in our evaluation. Your assistance is greatly appreciated.

In the blocks below, please indicate your overall level of satisfaction with the work performed by the firm shown in Section 1. Please include additional comments on a separate sheet of paper, including project number found in heading.

ITEM	ITEMS TO EVALUATED FOR THIS PROJECT	ACCEPTABLE	NON - ACCEPTABLE
1	Provided project schedules and completed most major milestones for the project on time.	<input type="checkbox"/>	<input type="checkbox"/>
2	Delivered Quality Construction?	<input type="checkbox"/>	<input type="checkbox"/>
3	Demonstrated a Willingness to Cooperate	<input type="checkbox"/>	<input type="checkbox"/>
4	Demonstrated Problem Solving Skills?	<input type="checkbox"/>	<input type="checkbox"/>
5	Managed the Project Effectively (including adequate Cost Controls)?	<input type="checkbox"/>	<input type="checkbox"/>
6	Managed Workforce Effectively, to include subcontractors?	<input type="checkbox"/>	<input type="checkbox"/>
7	Provided Adequate Warranty Support?	<input type="checkbox"/>	<input type="checkbox"/>
8	Kept You Informed on current status, problems, conditions, etc that affected the project?	<input type="checkbox"/>	<input type="checkbox"/>
9	Were payments withheld or liquidated damages assessed?	<input type="checkbox"/>	<input type="checkbox"/>
10	Effective subcontract/management plan? Did the firm make subcontracting goals?	<input type="checkbox"/>	<input type="checkbox"/>
11	Would they be your choice on future projects?	<input type="checkbox"/>	<input type="checkbox"/>
12	Your OVERALL Level of Customer Satisfaction	ACCEPTABLE	NON- ACCEPTABLE

Your Name _____ **Phone Number** _____

Firm Name _____

Relationship to this Project: _____

Your assistance in providing this past performance information is appreciated.

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Section 00600 - Representations & Certifications

SECTION 00600 TABLE OF CONTENT

Section 00600 - Representations & Certifications

CLAUSES INCORPORATED IN FULL TEXT

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52.204-3	Taxpayer Identification	OCT 1998
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52.209-5	Certification Regarding Debarment, Suspension, Proposed Debarment, And Other Responsibility Matters	DEC 2001
52.219-1 Alt I	Small Business Program Representations (Apr 2002) Alternate I	APR 2002
52.219-2	Equal Low Bids	OCT 1995
52.219-4	Notice of Price Evaluation Preference for HUBZone Small Business Concerns	JAN 1999
52.219-19	Small Business Concerns Representation For The Small Business Competitiveness Demonstration Program	OCT 2000
52.222-22	Previous Contracts And Compliance Reports	FEB 1999
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252.209-7001	Disclosure of Ownership or Control by the Government of a Terrorist Country	MAR 1998
252.209-7002	Disclosure Of Ownership Or Control By A Foreign Government	SEP 1994
252.247-7023	Transportation of Supplies by Sea	MAY 2002

CLAUSES INCORPORATED BY FULL TEXT

52.203-2 CERTIFICATE OF INDEPENDENT PRICE DETERMINATION (APR 1985)

(a) The offeror certifies that --

(1) The prices in this offer have been arrived at independently, without, for the purpose of restricting competition, any consultation, communication, or agreement with any other offeror or competitor relating to --

(i) Those prices,

(ii) The intention to submit an offer, or

(iii) The methods of factors used to calculate the prices offered:

(2) The prices in this offer have not been and will not be knowingly disclosed by the offeror, directly or indirectly, to any other offeror or competitor before bid opening (in the case of a sealed bid solicitation) or contract award (in the case of a negotiated solicitation) unless otherwise required by law; and

(3) No attempt has been made or will be made by the offeror to induce any other concern to submit or not to submit an offer for the purpose of restricting competition.

(b) Each signature on the offer is considered to be a certification by the signatory that the signatory --

(1) Is the person in the offeror's organization responsible for determining the prices offered in this bid or proposal, and that the signatory has not participated and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision; or

(2) (i) Has been authorized, in writing, to act as agent for the following principals in certifying that those principals have not participated, and will not participate in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision _____ (insert full name of person(s) in the offeror's organization responsible for determining the prices offered in this bid or proposal, and the title of his or her position in the offeror's organization);

(ii) As an authorized agent, does certify that the principals named in subdivision (b)(2)(i) above have not participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) above; and

(iii) As an agent, has not personally participated, and will not participate, in any action contrary to subparagraphs (a)(1) through (a)(3) of this provision.

(c) If the offeror deletes or modifies subparagraph (a)(2) of this provision, the offeror must furnish with its offer a signed statement setting forth in detail the circumstances of the disclosure.

(End of clause)

52.203-11 CERTIFICATION AND DISCLOSURE REGARDING PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (APR 1991)

(a) The definitions and prohibitions contained in the clause, at FAR 52.203-12, Limitation on Payments to Influence Certain Federal Transactions, included in this solicitation, are hereby incorporated by reference in paragraph (b) of this Certification.

(b) The offeror, by signing its offer, hereby certifies to the best of his or her knowledge and belief that on or after December 23, 1989,--

(1) No Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress on his or her behalf in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment or modification of any Federal contract, grant, loan, or cooperative agreement;

(2) If any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress or an employee of a Member of Congress on his or her behalf in connection with this solicitation, the offeror shall complete and submit, with its offer, OMB standard form LLL, Disclosure of Lobbying Activities, to the Contracting Officer; and

(3) He or she will include the language of this certification in all subcontract awards at any tier and require that all recipients of subcontract awards in excess of \$100,000 shall certify and disclose accordingly.

(2) Submission of this certification and disclosure is a prerequisite for making or entering into this contract imposed by section 1352, title 31, United States Code. Any person who makes an expenditure prohibited under this provision, shall be subject to a civil penalty of not less than \$10,000, and not more than \$100,000, for each such failure.

(End of provision)

52.204-3 TAXPAYER IDENTIFICATION (OCT 1998)

(a) Definitions.

“Common parent,” as used in this provision, means that corporate entity that owns or controls an affiliated group of corporations that files its Federal income tax returns on a consolidated basis, and of which the offeror is a member.

“Taxpayer Identification Number (TIN),” as used in this provision, means the number required by the Internal Revenue Service (IRS) to be used by the offeror in reporting income tax and other returns. The TIN may be either a Social Security Number or an Employer Identification Number.

(b) All offerors must submit the information required in paragraphs (d) through (f) of this provision to comply with debt collection requirements of 31 U.S.C. 7701(c) and 3325(d), reporting requirements of 26 U.S.C. 6041, 6041A, and 6050M, and implementing regulations issued by the IRS. If the resulting contract is subject to the payment reporting requirements described in Federal Acquisition Regulation (FAR) 4.904, the failure or refusal by the offeror to furnish the information may result in a 31 percent reduction of payments otherwise due under the contract.

(c) The TIN may be used by the Government to collect and report on any delinquent amounts arising out of the offeror's relationship with the Government (31 U.S.C. 7701(c)(3)). If the resulting contract is subject to the payment reporting requirements described in FAR 4.904, the TIN provided hereunder may be matched with IRS records to verify the accuracy of the offeror's TIN.

(d) Taxpayer Identification Number (TIN).

___ TIN: _____

___ TIN has been applied for.

___ TIN is not required because:

___ Offeror is a nonresident alien, foreign corporation, or foreign partnership that does not have income effectively connected with the conduct of a trade or business in the United States and does not have an office or place of business or a fiscal paying agent in the United States;

___ Offeror is an agency or instrumentality of a foreign government;

___ Offeror is an agency or instrumentality of the Federal Government.

(e) Type of organization.

___ Sole proprietorship;

___ Partnership;

___ Corporate entity (not tax-exempt);

___ Corporate entity (tax-exempt);

___ Government entity (Federal, State, or local);

___ Foreign government;

___ International organization per 26 CFR 1.6049-4;

___ Other _____

(f) Common parent.

___ Offeror is not owned or controlled by a common parent as defined in paragraph (a) of this provision.

___ Name and TIN of common parent:

Name _____

TIN _____

(End of provision)

52.204-5 WOMEN-OWNED BUSINESS (OTHER THAN SMALL BUSINESS) (MAY 1999)

(a) Definition. Women-owned business concern, as used in this provision, means a concern that is at least 51 percent owned by one or more women; or in the case of any publicly owned business, at least 51 percent of its stock is owned by one or more women; and whose management and daily business operations are controlled by one or more women.

(b) Representation. [Complete only if the offeror is a women-owned business concern and has not represented itself as a small business concern in paragraph (b)(1) of FAR 52.219-1, Small Business Program Representations, of this solicitation.] The offeror represents that it () is a women-owned business concern.

(End of provision)

52.209-5 CERTIFICATION REGARDING DEBARMENT, SUSPENSION, PROPOSED DEBARMENT, AND OTHER RESPONSIBILITY MATTERS (DEC 2001)

(a)(1) The Offeror certifies, to the best of its knowledge and belief, that--

(i) The Offeror and/or any of its Principals --

(A) Are () are not () presently debarred, suspended, proposed for debarment, or declared ineligible for the award of contracts by any Federal agency;

(B) Have () have not (), within a three-year period preceding this offer, been convicted of or had a civil judgment rendered against them for: commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, state, or local) contract or subcontract; violation of Federal or state antitrust statutes relating to the submission of offers; or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, tax evasion, or receiving stolen property; and

(C) Are () are not () presently indicted for, or otherwise criminally or civilly charged by a governmental entity with, commission of any of the offenses enumerated in subdivision (a)(1)(i)(B) of this provision.

(ii) The Offeror has () has not (), within a three-year period preceding this offer, had one or more contracts terminated for default by any Federal agency.

(2) "Principals," for the purposes of this certification, means officers; directors; owners; partners; and, persons having primary management or supervisory responsibilities within a business entity (e.g., general manager; plant manager; head of a subsidiary, division, or business segment, and similar positions).

THIS CERTIFICATION CONCERNS A MATTER WITHIN THE JURISDICTION OF AN AGENCY OF THE UNITED STATES AND THE MAKING OF A FALSE, FICTITIOUS, OR FRAUDULENT CERTIFICATION MAY RENDER THE MAKER SUBJECT TO PROSECUTION UNDER SECTION 1001, TITLE 18, UNITED STATES CODE.

(b) The Offeror shall provide immediate written notice to the Contracting Officer if, at any time prior to contract award, the Offeror learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

(c) A certification that any of the items in paragraph (a) of this provision exists will not necessarily result in withholding of an award under this solicitation. However, the certification will be considered in connection with a determination of the Offeror's responsibility. Failure of the Offeror to furnish a certification or provide such additional information as requested by the Contracting Officer may render the Offeror nonresponsible.

(d) Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render, in good faith, the certification required by paragraph (a) of this provision. The knowledge and information of an Offeror is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

(e) The certification in paragraph (a) of this provision is a material representation of fact upon which reliance was

placed when making award. If it is later determined that the Offeror knowingly rendered an erroneous certification, in addition to other remedies available to the Government, the Contracting Officer may terminate the contract resulting from this solicitation for default.

(End of provision)

52.219-1 SMALL BUSINESS PROGRAM REPRESENTATIONS (APR 2002) - ALTERNATE I (APR 2002)

(a)(1) The North American Industry Classification System (NAICS) code for this acquisition is (23332) (insert NAICS code).

(2) The small business size standard is (\$28,500,000) (insert size standard).

(3) The small business size standard for a concern which submits an offer in its own name, other than on a construction or service contract, but which proposes to furnish a product which it did not itself manufacture, is 500 employees.

(b) Representations. (1) The offeror represents as part of its offer that it () is, () is not a small business concern.

(2) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents, for general statistical purposes, that it () is, () is not a small disadvantaged business concern as defined in 13 CFR 124.1002.

(3) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it () is, () is not a women-owned small business concern.

(4) (Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.) The offeror represents as part of its offer that it () is, () is not a veteran-owned small business concern.

(5) (Complete only if the offeror represented itself as a veteran-owned small business concern in paragraph (b)(4) of this provision.) The offeror represents as part of its offer that it () is, () is not a service-disabled veteran-owned small business concern.

(6) [Complete only if the offeror represented itself as a small business concern in paragraph (b)(1) of this provision.] The offeror represents, as part of its offer, that--

(i) It () is, () is not a HUBZone small business concern listed, on the date of this representation, on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration, and no material change in ownership and control, principal office, or HUBZone employee percentage has occurred since it was certified by the Small Business Administration in accordance with 13 CFR part 126; and

(ii) It () is, () is not a joint venture that complies with the requirements of 13 CFR part 126, and the representation in paragraph (b)(6)(i) of this provision is accurate for the HUBZone small business concern or concerns that are participating in the joint venture. (The offeror shall enter the name or names of the HUBZone small business concern or concerns that are participating in the joint venture: _____.) Each HUBZone small business concern participating in the joint venture shall submit a separate signed copy of the HUBZone representation.

(7) (Complete if offeror represented itself as disadvantaged in paragraph (b)(2) of this provision.) The offeror shall check the category in which its ownership falls:

_____ Black American.

_____ Hispanic American.

_____ Native American (American Indians, Eskimos, Aleuts, or Native Hawaiians).

_____ Asian-Pacific American (persons with origins from Burma, Thailand, Malaysia, Indonesia, Singapore, Brunei, Japan, China, Taiwan, Laos, Cambodia (Kampuchea), Vietnam, Korea, The Philippines, U.S. Trust Territory of the Pacific Islands (Republic of Palau), Republic of the Marshall Islands, Federated States of Micronesia, the Commonwealth of the Northern Mariana Islands, Guam, Samoa, Macao, Hong Kong, Fiji, Tonga, Kiribati, Tuvalu, or Nauru).

_____ Subcontinent Asian (Asian-Indian) American (persons with origins from India, Pakistan, Bangladesh, Sri Lanka, Bhutan, the Maldives Islands, or Nepal).

_____ Individual/concern, other than one of the preceding.

(c) Definitions. As used in this provision--

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

"Small business concern," means a concern, including its affiliates, that is independently owned and operated, not dominant in the field of operation in which it is bidding on Government contracts, and qualified as a small business under the criteria in 13 CFR Part 121 and the size standard in paragraph (a) of this provision.

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

"Women-owned small business concern," means a small business concern --

(1) That is at least 51 percent owned by one or more women or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; or

(2) Whose management and daily business operations are controlled by one or more women.

(d) Notice.

(1) If this solicitation is for supplies and has been set aside, in whole or in part, for small business concerns, then the clause in this solicitation providing notice of the set-aside contains restrictions on the source of the end items to be furnished.

(2) Under 15 U.S.C. 645(d), any person who misrepresents a firm's status as a small, HUBZone small, small disadvantaged, or women-owned small business concern in order to obtain a contract to be awarded under the preference programs established pursuant to section 8(a), 8(d), 9, or 15 of the Small Business Act or any other provision of Federal law that specifically references section 8(d) for a definition of program eligibility, shall--

- (i) Be punished by imposition of fine, imprisonment, or both;
- (ii) Be subject to administrative remedies, including suspension and debarment; and
- (iii) Be ineligible for participation in programs conducted under the authority of the Act.

(End of provision)

52.219-2 EQUAL LOW BIDS. (OCT 1995)

- (a) This provision applies to small business concerns only.
- (b) The bidder's status as a labor surplus area (LSA) concern may affect entitlement to award in case of tie bids. If the bidder wishes to be considered for this priority, the bidder must identify, in the following space, the LSA in which the costs to be incurred on account of manufacturing or production (by the bidder or the first-tier subcontractors) amount to more than 50 percent of the contract price.

(c) Failure to identify the labor surplus area as specified in paragraph (b) of this provision will preclude the bidder from receiving priority consideration. If the bidder is awarded a contract as a result of receiving priority consideration under this provision and would not have otherwise received award, the bidder shall perform the contract or cause the contract to be performed in accordance with the obligations of an LSA concern.

52.219-4 NOTICE OF PRICE EVALUATION PREFERENCE FOR HUBZONE SMALL BUSINESS CONCERNS (JAN 1999)

- (a) Definition. HUBZone small business concern, as used in this clause, means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.
- (b) Evaluation preference. (1) Offers will be evaluated by adding a factor of 10 percent to the price of all offers, except--
 - (i) Offers from HUBZone small business concerns that have not waived the evaluation preference;
 - (ii) Otherwise successful offers from small business concerns;

(iii) Otherwise successful offers of eligible products under the Trade Agreements Act when the dollar threshold for application of the Act is exceeded (see 25.402 of the Federal Acquisition Regulation (FAR)); and

(iv) Otherwise successful offers where application of the factor would be inconsistent with a Memorandum of Understanding or other international agreement with a foreign government.

(2) The factor of 10 percent shall be applied on a line item basis or to any group of items on which award may be made. Other evaluation factors described in the solicitation shall be applied before application of the factor.

(3) A concern that is both a HUBZone small business concern and a small disadvantaged business concern will receive the benefit of both the HUBZone small business price evaluation preference and the small disadvantaged business price evaluation adjustment (see FAR clause 52.219-23). Each applicable price evaluation preference or adjustment shall be calculated independently against an offeror's base offer.

These individual preference amounts shall be added together to arrive at the total evaluated price for that offer.

(c) Waiver of evaluation preference. A HUBZone small business concern may elect to waive the evaluation preference, in which case the factor will be added to its offer for evaluation purposes. The agreements in paragraph (d) of this clause do not apply if the offeror has waived the evaluation preference.

___ Offeror elects to waive the evaluation preference.

(d) Agreement. A HUBZone small business concern agrees that in the performance of the contract, in the case of a contract for

(1) Services (except construction), at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern or employees of other HUBZone small business concerns;

(2) Supplies (other than procurement from a nonmanufacturer of such supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern or other HUBZone small business concerns;

(3) General construction, at least 15 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns; or

(4) Construction by special trade contractors, at least 25 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns.

(e) A HUBZone joint venture agrees that in the performance of the contract, the applicable percentage specified in paragraph (d) of this clause will be performed by the HUBZone small business participant or participants.

(f) A HUBZone small business concern nonmanufacturer agrees to furnish in performing this contract only end items manufactured or produced by HUBZone small business manufacturer concerns. This paragraph does not apply in connection with construction or service contracts.

(End of clause)

52.219-19 SMALL BUSINESS CONCERN REPRESENTATION FOR THE SMALL BUSINESS COMPETITIVENESS DEMONSTRATION PROGRAM (OCT 2000)

(a) Definition.

"Emerging small business" as used in this solicitation, means a small business concern whose size is no greater than 50 percent of the numerical size standard applicable to the North American Industry Classification System (NAICS) code assigned to a contracting opportunity.

(b) [Complete only if the Offeror has represented itself under the provision at 52.219-1 as a small business concern under the size standards of this solicitation.] The Offeror [] is, [] is not an emerging small business.

(c) (Complete only if the Offeror is a small business or an emerging small business, indicating its size range.)

Offeror's number of employees for the past 12 months (check this column if size standard stated in solicitation is expressed in terms of number of employees) or Offeror's average annual gross revenue for the last 3 fiscal years (check this column if size standard stated in solicitation is expressed in terms of annual receipts). (Check one of the following.)

No. of Employees Avg. Annual Gross Revenues

___ 50 or fewer	___ \$1 million or less
___ 51 - 100	___ \$1,000,001 - \$2 million
___ 101 - 250	___ \$2,000,001 - \$3.5 million
___ 251 - 500	___ \$3,500,001 - \$5 million
___ 501 - 750	___ \$5,000,001 - \$10 million
___ 751 - 1,000	___ \$10,000,001 - \$17 million
___ Over 1,000	___ Over \$17 million

(End of provision)

52.222-22 PREVIOUS CONTRACTS AND COMPLIANCE REPORTS (FEB 1999)

The offeror represents that --

(a) () It has, () has not participated in a previous contract or subcontract subject to the Equal Opportunity clause of this solicitation;

(b) () It has, () has not, filed all required compliance reports; and

(c) Representations indicating submission of required compliance reports, signed by proposed subcontractors, will be obtained before subcontract awards.

(End of provision)

52.222-25 AFFIRMATIVE ACTION COMPLIANCE (APR 1984)

The offeror represents that

(a) [] it has developed and has on file, [] has not developed and does not have on file, at each establishment,

affirmative action programs required by the rules and regulations of the Secretary of Labor (41 CFR 60-1 and 60-2), or

(b) ☐ has not previously had contracts subject to the written affirmative action programs requirement of the rules and regulations of the Secretary of Labor.

(End of provision)

52.223-4 RECOVERED MATERIAL CERTIFICATION (OCT 1997)

As required by the Resource Conservation and Recovery Act of 1976 (42 U.S.C. 6962(c)(3)(A)(i)), the offeror certifies, by signing this offer, that the percentage of recovered materials to be used in the performance of the contract will be at least the amount required by the applicable contract specifications.

(End of provision)

52.223-13 CERTIFICATION OF TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Submission of this certification is a prerequisite for making or entering into this contract imposed by Executive Order 12969, August 8, 1995.

(b) By signing this offer, the offeror certifies that--

(1) As the owner or operator of facilities that will be used in the performance of this contract that are subject to the filing and reporting requirements described in section 313 of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023) and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106), the offeror will file and continue to file for such facilities for the life of the contract the Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of EPCRA and section 6607 of PPA; or

(2) None of its owned or operated facilities to be used in the performance of this contract is subject to the Form R filing and reporting requirements because each such facility is exempt for at least one of the following reasons:
(Check each block that is applicable.)

☐ (i) The facility does not manufacture, process or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

☐ (ii) The facility does not have 10 or more full-time employees as specified in section 313.(b)(1)(A) of EPCRA 42 U.S.C. 11023(b)(1)(A);

☐ (iii) The facility does not meet the reporting thresholds of toxic chemicals established under section 313(f) of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

☐ (iv) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

☐ (v) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(End of clause)

52.236-28 PREPARATION OF PROPOSALS--CONSTRUCTION (OCT 1997)

- (a) Proposals must be (1) submitted on the forms furnished by the Government or on copies of those forms, and (2) manually signed. The person signing a proposal must initial each erasure or change appearing on any proposal form.
- (b) The proposal form may require offerors to submit proposed prices for one or more items on various bases, including--
 - (1) Lump sum price;
 - (2) Alternate prices;
 - (3) Units of construction; or
 - (4) Any combination of paragraphs (b)(1) through (b)(3) of this provision.
- (c) If the solicitation requires submission of a proposal on all items, failure to do so may result in the proposal being rejected without further consideration. If a proposal on all items is not required, offerors should insert the words "no proposal" in the space provided for any item on which no price is submitted.
- (d) Alternate proposals will not be considered unless this solicitation authorizes their submission.
- (End of provision)

252.209-7001 DISCLOSURE OF OWNERSHIP OR CONTROL BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) "Definitions."

As used in this provision --

- (a) "Government of a terrorist country" includes the state and the government of a terrorist country, as well as any political subdivision, agency, or instrumentality thereof.
- (2) "Terrorist country" means a country determined by the Secretary of State, under section 6(j)(1)(A) of the Export Administration Act of 1979 (50 U.S.C. App. 2405(j)(i)(A)), to be a country the government of which has repeatedly provided support for such acts of international terrorism. As of the date of this provision, terrorist countries include: Cuba, Iran, Iraq, Libya, North Korea, Sudan, and Syria.
- (3) "Significant interest" means --
 - (i) Ownership of or beneficial interest in 5 percent or more of the firm's or subsidiary's securities. Beneficial interest includes holding 5 percent or more of any class of the firm's securities in "nominee shares," "street names," or some other method of holding securities that does not disclose the beneficial owner;
 - (ii) Holding a management position in the firm, such as a director or officer;
 - (iii) Ability to control or influence the election, appointment, or tenure of directors or officers in the firm;

(iv) Ownership of 10 percent or more of the assets of a firm such as equipment, buildings, real estate, or other tangible assets of the firm; or

(v) Holding 50 percent or more of the indebtedness of a firm.

(b) "Prohibition on award."

In accordance with 10 U.S.C. 2327, no contract may be awarded to a firm or a subsidiary of a firm if the government of a terrorist country has a significant interest in the firm or subsidiary or, in the case of a subsidiary, the firm that owns the subsidiary, unless a waiver is granted by the Secretary of Defense.

(c) "Disclosure."

If the government of a terrorist country has a significant interest in the Offeror or a subsidiary of the Offeror, the Offeror shall disclose such interest in an attachment to its offer. If the Offeror is a subsidiary, it shall also disclose any significant interest the government of a terrorist country has in any firm that owns or controls the subsidiary. The disclosure shall include --

(1) Identification of each government holding a significant interest; and

(2) A description of the significant interest held by each government.

(End of provision)

252.209-7002 DISCLOSURE OF OWNERSHIP OR CONTROL BY A FOREIGN GOVERNMENT (SEP 1994)

(a) Definitions. As used in this provision--

(1) "Entity controlled by a foreign government" means--

(i) Any domestic or foreign organization or corporation that is effectively owned or controlled by a foreign government; or

(ii) Any individual acting on behalf of a foreign government.

(2) "Effectively owned or controlled" means that a foreign government or any entity controlled by a foreign government has the power, either directly or indirectly, whether exercised or exercisable, to control or influence the election or appointment of the Offeror's officers, directors, partners, regents, trustees, or a majority of the Offeror's board of directors by means, e.g., ownership, contract, or operation of law.

(3) "Foreign government" means any governing body organized and existing under the laws of any country other than the United States and its possessions and trust territories and any agent or instrumentality of that government.

(4) "Proscribed information" means--

(i) Top Secret information;

(ii) Communications Security (COMSEC) information, except classified keys used to operate secure telephone units (STU IIIs);

(iii) Restricted Data as defined in the U.S. Atomic Energy Act of 1954, as amended;

(iv) Special Access Program (SAP) information; or

(v) Sensitive Compartmental Information (SCI).

(b) Prohibition on award. No contract under a national security program may be awarded to a company owned by an entity controlled by a foreign government if that company requires access to proscribed information to perform the contract, unless the Secretary of Defense or designee has waived application of 10 U.S.C.2536(a).

(c) Disclosure.

The Offeror shall disclose any interest a foreign government has in the Offeror when that interest constitutes control by a foreign government as defined in this provision. If the Offeror is a subsidiary, it shall also disclose any reportable interest a foreign government has in any entity that owns or controls the subsidiary, including reportable interest concerning the Offeror's immediate parent, intermediate parents, and the ultimate parent. Use separate paper as needed, and provide the information in the following format:

Offeror's Point of Contact for Questions about Disclosure

(Name and Phone Number with Country Code, City Code and Area Code, as applicable)

Name and Address of Offeror

Name and Address of Entity

Description of Interest, Controlled by a Foreign
Ownership Percentage, and

Government Identification of Foreign Government

(End of provision)

252.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (MAY 2002)

(a) Definitions. As used in this clause --

(1) "Components" means articles, materials, and supplies incorporated directly into end products at any level of manufacture, fabrication, or assembly by the Contractor or any subcontractor.

(2) "Department of Defense" (DoD) means the Army, Navy, Air Force, Marine Corps, and defense agencies.

(3) "Foreign flag vessel" means any vessel that is not a U.S.-flag vessel.

(4) "Ocean transportation" means any transportation aboard a ship, vessel, boat, barge, or ferry through international waters.

(5) "Subcontractor" means a supplier, materialman, distributor, or vendor at any level below the prime contractor whose contractual obligation to perform results from, or is conditioned upon, award of the prime contract and who is performing any part of the work or other requirement of the prime contract.

(6) "Supplies" means all property, except land and interests in land, that is clearly identifiable for eventual use by or owned by the DoD at the time of transportation by sea.

(i) An item is clearly identifiable for eventual use by the DoD if, for example, the contract documentation contains a reference to a DoD contract number or a military destination.

(ii) "Supplies" includes (but is not limited to) public works; buildings and facilities; ships; floating equipment and vessels of every character, type, and description, with parts, subassemblies, accessories, and equipment; machine tools; material; equipment; stores of all kinds; end items; construction materials; and components of the foregoing.

(7) "U.S.-flag vessel" means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.

(b)(1) The Contractor shall use U.S.-flag vessels when transporting any supplies by sea under this contract.

(2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flag vessels if--

(i) This contract is a construction contract; or

(ii) The supplies being transported are--

(A) Noncommercial items; or

(B) Commercial items that--

(1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it contracts for f.o.b. destination shipment);

(2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(c) The Contractor and its subcontractors may request that the Contracting Officer authorize shipment in foreign-flag vessels, or designate available U.S.-flag vessels, if the Contractor or a subcontractor believes that --

(1) U.S.-flag vessels are not available for timely shipment;

(2) The freight charges are inordinately excessive or unreasonable; or

(3) Freight charges are higher than charges to private persons for transportation of like goods.

(d) The Contractor must submit any request for use of other than U.S.-flag vessels in writing to the Contracting Officer at least 45 days prior to the sailing date necessary to meet its delivery schedules. The Contracting Officer will process requests submitted after such date(s) as expeditiously as possible, but the Contracting Officer's failure to grant approvals to meet the shipper's sailing date will not of itself constitute a compensable delay under this or any other clause of this contract. Requests shall contain at a minimum --

(1) Type, weight, and cube of cargo;

(2) Required shipping date;

(3) Special handling and discharge requirements;

(4) Loading and discharge points;

(5) Name of shipper and consignee;

(6) Prime contract number; and

(7) A documented description of efforts made to secure U.S.-flag vessels, including points of contact (with names and telephone numbers) with at least two U.S.-flag carriers contacted. Copies of telephone notes, telegraphic and

facsimile message or letters will be sufficient for this purpose.

(e) The Contractor shall, within 30 days after each shipment covered by this clause, provide the Contracting Officer and the Maritime Administration, Office of Cargo Preference, U.S. Department of Transportation, 400 Seventh Street SW., Washington, DC 20590, one copy of the rated on board vessel operating carrier's ocean bill of lading, which shall contain the following information:

- (1) Prime contract number;
- (2) Name of vessel;
- (3) Vessel flag of registry;
- (4) Date of loading;
- (5) Port of loading;
- (6) Port of final discharge;
- (7) Description of commodity;
- (8) Gross weight in pounds and cubic feet if available;
- (9) Total ocean freight in U.S. dollars; and
- (10) Name of the steamship company.

(f) The Contractor shall provide with its final invoice under this contract a representation that to the best of its knowledge and belief--

- (1) No ocean transportation was used in the performance of this contract;
- (2) Ocean transportation was used and only U.S.-flag vessels were used for all ocean shipments under the contract;
- (3) Ocean transportation was used, and the Contractor had the written consent of the Contracting Officer for all non-U.S.-flag ocean transportation; or
- (4) Ocean transportation was used and some or all of the shipments were made on non-U.S.-flag vessels without the written consent of the Contracting Officer. The Contractor shall describe these shipments in the following format:

ITEM DESCRIPTION	CONTRACT LINE ITEMS	QUANTITY
_____	_____	_____
_____	_____	_____
_____	_____	_____
TOTAL _____		

(g) If the final invoice does not include the required representation, the Government will reject and return it to the Contractor as an improper invoice for the purposes of the Prompt Payment clause of this contract. In the event there has been unauthorized use of non-U.S.-flag vessels in the performance of this contract, the Contracting Officer is entitled to equitably adjust the contract, based on the unauthorized use.

(h) In the award of subcontracts for the types of supplies described in paragraph (b)(2) of this clause, the Contractor shall flow down the requirements of this clause as follows:

(1) The Contractor shall insert the substance of this clause, including this paragraph (h), in subcontracts that exceed the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(2) The Contractor shall insert the substance of paragraphs (a) through (e) of this clause, and this paragraph (h), in subcontracts that are at or below the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(End of clause)

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Section 00700 - Contract Clauses

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Successor Contracting Officers (52.201-4001)

The Contracting Officer who signed this contract is the primary Contracting Officer for the contract. Nevertheless, any Contracting Officer assigned to the Seattle District and acting within his/her authority may take formal action on this contract when a contract action needs to be taken and the primary Contracting Officer is unavailable.

52.202-1 DEFINITIONS (MAY 2001) --ALTERNATE I (MAR 2001)

(a) Agency head or head of the agency means the Secretary (Attorney General, Administrator, Governor, Chairperson, or other chief official, as appropriate) of the agency, unless otherwise indicated, including any deputy or assistant chief official of the executive agency.

(b) Commercial component means any component that is a commercial item.

(c) Component means any item supplied to the Government as part of an end item or of another component, except that for use in 52.225-9, and 52.225-11 see the definitions in 52.225-9(a) and 52.225-11(a).

(d) Contracting Officer means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(e) Nondevelopmental item means--

(1) Any previously developed item of supply used exclusively for governmental purposes by a Federal agency, a State or local government, or a foreign government with which the United States has a mutual defense cooperation agreement;

(2) Any item described in paragraph (f)(1) of this definition that requires only minor modification or modifications of a type customarily available in the commercial marketplace in order to meet the requirements of the procuring department or agency; or

(3) Any item of supply being produced that does not meet the requirements of paragraph (f)(1) or (f)(2) solely because the item is not yet in use.

(f) "Contracting Officer" means a person with the authority to enter into, administer, and/or terminate contracts and make related determinations and findings. The term includes certain authorized representatives of the Contracting Officer acting within the limits of their authority as delegated by the Contracting Officer.

(g) Except as otherwise provided in this contract, the term "subcontracts" includes, but is not limited to, purchase orders and changes and modifications to purchase orders under this contract.

(End of clause)

52.203-3 GRATUITIES (APR 1984)

(a) The right of the Contractor to proceed may be terminated by written notice if, after notice and hearing, the agency head or a designee determines that the Contractor, its agent, or another representative--

(1) Offered or gave a gratuity (e.g., an entertainment or gift) to an officer, official, or employee of the Government; and

(2) Intended, by the gratuity, to obtain a contract or favorable treatment under a contract.

(b) The facts supporting this determination may be reviewed by any court having lawful jurisdiction.

(c) If this contract is terminated under paragraph (a) of this clause, the Government is entitled--

(1) To pursue the same remedies as in a breach of the contract; and

(2) In addition to any other damages provided by law, to exemplary damages of not less than 3 nor more than 10 times the cost incurred by the Contractor in giving gratuities to the person concerned, as determined by the agency head or a designee. (This subparagraph (c)(2) is applicable only if this contract uses money appropriated to the Department of Defense.)

(d) The rights and remedies of the Government provided in this clause shall not be exclusive and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-5 COVENANT AGAINST CONTINGENT FEES (APR 1984)

(a) The Contractor warrants that no person or agency has been employed or retained to solicit or obtain this contract upon an agreement or understanding for a contingent fee, except a bona fide employee or agency. For breach or violation of this warranty, the Government shall have the right to annul this contract without liability or, in its discretion, to deduct from the contract price or consideration, or otherwise recover, the full amount of the contingent fee.

(b) "Bona fide agency," as used in this clause, means an established commercial or selling agency, maintained by a contractor for the purpose of securing business, that neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds itself out as being able to obtain any Government contract or contracts through improper influence.

"Bona fide employee," as used in this clause, means a person, employed by a contractor and subject to the contractor's supervision and control as to time, place, and manner of performance, who neither exerts nor proposes to exert improper influence to solicit or obtain Government contracts nor holds out as being able to obtain any Government contract or contracts through improper influence.

"Contingent fee," as used in this clause, means any commission, percentage, brokerage, or other fee that is contingent upon the success that a person or concern has in securing a Government contract.

"Improper influence," as used in this clause, means any influence that induces or tends to induce a Government employee or officer to give consideration or to act regarding a Government contract on any basis other than the merits of the matter.

(End of clause)

52.203-7 ANTI-KICKBACK PROCEDURES. (JUL 1995)

(a) Definitions.

"Kickback," as used in this clause, means any money, fee, commission, credit, gift, gratuity, thing of value, or compensation of any kind which is provided, directly or indirectly, to any prime Contractor, prime Contractor employee, subcontractor, or subcontractor employee for the purpose of improperly obtaining or rewarding favorable treatment in connection with a prime contract or in connection with a subcontract relating to a prime contract.

"Person," as used in this clause, means a corporation, partnership, business association of any kind, trust, joint-stock company, or individual.

"Prime contract," as used in this clause, means a contract or contractual action entered into by the United States for the purpose of obtaining supplies, materials, equipment, or services of any kind.

"Prime Contractor," as used in this clause, means a person who has entered into a prime contract with the United States.

"Prime Contractor employee," as used in this clause, means any officer, partner, employee, or agent of a prime Contractor.

"Subcontract," as used in this clause, means a contract or contractual action entered into by a prime Contractor or

subcontractor for the purpose of obtaining supplies, materials, equipment, or services of any kind under a prime contract.

"Subcontractor," as used in this clause, (1) means any person, other than the prime Contractor, who offers to furnish or furnishes any supplies, materials, equipment, or services of any kind under a prime contract or a subcontract entered into in connection with such prime contract, and (2) includes any person who offers to furnish or furnishes general supplies to the prime Contractor or a higher tier subcontractor.

"Subcontractor employee," as used in this clause, means any officer, partner, employee, or agent of a subcontractor.

(b) The Anti-Kickback Act of 1986 (41 U.S.C. 51-58) (the Act), prohibits any person from -

(1) Providing or attempting to provide or offering to provide any kickback;

(2) Soliciting, accepting, or attempting to accept any kickback; or

(3) Including, directly or indirectly, the amount of any kickback in the contract price charged by a prime Contractor to the United States or in the contract price charged by a subcontractor to a prime Contractor or higher tier subcontractor.

(c)(1) The Contractor shall have in place and follow reasonable procedures designed to prevent and detect possible violations described in paragraph (b) of this clause in its own operations and direct business relationships.

(2) When the Contractor has reasonable grounds to believe that a violation described in paragraph (b) of this clause may have occurred, the Contractor shall promptly report in writing the possible violation. Such reports shall be made to the inspector general of the contracting agency, the head of the contracting agency if the agency does not have an inspector general, or the Department of Justice.

(3) The Contractor shall cooperate fully with any Federal agency investigating a possible violation described in paragraph (b) of this clause.

(4) The Contracting Officer may (i) offset the amount of the kickback against any monies owed by the United States under the prime contract and/or (ii) direct that the Prime Contractor withhold, from sums owed a subcontractor under the prime contract, the amount of any kickback. The Contracting Officer may order the monies withheld under subdivision (c)(4)(ii) of this clause be paid over to the Government unless the Government has already offset those monies under subdivision (c)(4)(i) of this clause. In either case, the Prime Contractor shall notify the Contracting Officer when the monies are withheld.

(5) The Contractor agrees to incorporate the substance of this clause, including this subparagraph (c)(5) but excepting subparagraph (c)(1), in all subcontracts under this contract which exceed \$100,000.

52.203-8 CANCELLATION, RESCISSION, AND RECOVERY OF FUNDS FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

(a) If the Government receives information that a contractor or a person has engaged in conduct constituting a violation of subsection (a), (b), (c), or (d) of Section 27 of the Office of Federal Procurement Policy Act (41 U.S.C. 423) (the Act), as amended by section 4304 of the 1996 National Defense Authorization Act for Fiscal Year 1996 (Pub. L. 104-106), the Government may--

- (1) Cancel the solicitation, if the contract has not yet been awarded or issued; or
 - (2) Rescind the contract with respect to which--
 - (i) The Contractor or someone acting for the Contractor has been convicted for an offense where the conduct constitutes a violation of subsection 27(a) or (b) of the Act for the purpose of either--
 - (A) Exchanging the information covered by such subsections for anything of value; or
 - (B) Obtaining or giving anyone a competitive advantage in the award of a Federal agency procurement contract; or
 - (ii) The head of the contracting activity has determined, based upon a preponderance of the evidence, that the Contractor or someone acting for the Contractor has engaged in conduct constituting an offense punishable under subsections 27(e)(1) of the Act.
 - (b) If the Government rescinds the contract under paragraph (a) of this clause, the Government is entitled to recover, in addition to any penalty prescribed by law, the amount expended under the contract.
 - (c) The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law, regulation, or under this contract.
- (End of clause)

52.203-10 PRICE OR FEE ADJUSTMENT FOR ILLEGAL OR IMPROPER ACTIVITY (JAN 1997)

- (a) The Government, at its election, may reduce the price of a fixed-price type contract and the total cost and fee under a cost-type contract by the amount of profit or fee determined as set forth in paragraph (b) of this clause if the head of the contracting activity or designee determines that there was a violation of subsection 27 (a), (b), or (c) of the Office of Federal Procurement Policy Act, as amended (41 U.S.C. 423), as implemented in section 3.104 of the Federal Acquisition Regulation.
- (b) The price or fee reduction referred to in paragraph (a) of this clause shall be--
 - (1) For cost-plus-fixed-fee contracts, the amount of the fee specified in the contract at the time of award;
 - (2) For cost-plus-incentive-fee contracts, the target fee specified in the contract at the time of award, notwithstanding any minimum fee or "fee floor" specified in the contract;
 - (3) For cost-plus-award-fee contracts--
 - (i) The base fee established in the contract at the time of contract award;
 - (ii) If no base fee is specified in the contract, 30 percent of the amount of each award fee otherwise payable to the Contractor for each award fee evaluation period or at each award fee determination point.
 - (4) For fixed-price-incentive contracts, the Government may--
 - (i) Reduce the contract target price and contract target profit both by an amount equal to the initial target profit specified in the contract at the time of contract award; or
 - (ii) If an immediate adjustment to the contract target price and contract target profit would have a significant adverse

impact on the incentive price revision relationship under the contract, or adversely affect the contract financing provisions, the Contracting Officer may defer such adjustment until establishment of the total final price of the contract. The total final price established in accordance with the incentive price revision provisions of the contract shall be reduced by an amount equal to the initial target profit specified in the contract at the time of contract award and such reduced price shall be the total final contract price.

(5) For firm-fixed-price contracts, by 10 percent of the initial contract price or a profit amount determined by the Contracting Officer from records or documents in existence prior to the date of the contract award.

(c) The Government may, at its election, reduce a prime contractor's price or fee in accordance with the procedures of paragraph (b) of this clause for violations of the Act by its subcontractors by an amount not to exceed the amount of profit or fee reflected in the subcontract at the time the subcontract was first definitively priced.

(d) In addition to the remedies in paragraphs (a) and (c) of this clause, the Government may terminate this contract for default. The rights and remedies of the Government specified herein are not exclusive, and are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.203-12 LIMITATION ON PAYMENTS TO INFLUENCE CERTAIN FEDERAL TRANSACTIONS (JUN 1997)

(a) Definitions.

"Agency," as used in this clause, means executive agency as defined in 2.101.

"Covered Federal action," as used in this clause, means any of the following Federal actions:

- (1) The awarding of any Federal contract.
- (2) The making of any Federal grant.
- (3) The making of any Federal loan.
- (4) The entering into of any cooperative agreement.
- (5) The extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

"Indian tribe" and "tribal organization," as used in this clause, have the meaning provided in section 4 of the Indian Self-Determination and Education Assistance Act (25 U.S.C. 450B) and include Alaskan Natives.

"Influencing or attempting to influence," as used in this clause, means making, with the intent to influence, any communication to or appearance before an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any covered Federal action.

"Local government," as used in this clause, means a unit of government in a State and, if chartered, established, or otherwise recognized by a State for the performance of a governmental duty, including a local public authority, a special district, an intrastate district, a council of governments, a sponsor group representative organization, and any other instrumentality of a local government.

"Officer or employee of an agency," as used in this clause, includes the following individuals who are employed by an agency:

(1) An individual who is appointed to a position in the Government under Title 5, United States Code, including a position under a temporary appointment.

(2) A member of the uniformed services, as defined in subsection 101(3), Title 37, United States Code.

(3) A special Government employee, as defined in section 202, Title 18, United States Code.

(4) An individual who is a member of a Federal advisory committee, as defined by the Federal Advisory Committee Act, Title 5, United States Code, appendix 2.

"Person," as used in this clause, means an individual, corporation, company, association, authority, firm, partnership, society, State, and local government, regardless of whether such entity is operated for profit, or not for profit. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Reasonable compensation," as used in this clause, means, with respect to a regularly employed officer or employee of any person, compensation that is consistent with the normal compensation for such officer or employee for work that is not furnished to, not funded by, or not furnished in cooperation with the Federal Government.

"Reasonable payment," as used in this clause, means, with respect to professional and other technical services, a payment in an amount that is consistent with the amount normally paid for such services in the private sector.

"Recipient," as used in this clause, includes the Contractor and all subcontractors. This term excludes an Indian tribe, tribal organization, or any other Indian organization with respect to expenditures specifically permitted by other Federal law.

"Regularly employed," as used in this clause, means, with respect to an officer or employee of a person requesting or receiving a Federal contract, an officer or employee who is employed by such person for at least 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person for receipt of such contract. An officer or employee who is employed by such person for less than 130 working days within 1 year immediately preceding the date of the submission that initiates agency consideration of such person shall be considered to be regularly employed as soon as he or she is employed by such person for 130 working days.

"State," as used in this clause, means a State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, a territory or possession of the United States, an agency or instrumentality of a State, and multi-State, regional, or interstate entity having governmental duties and powers.

(b) Prohibitions.

(1) Section 1352 of Title 31, United States Code, among other things, prohibits a recipient of a Federal contract, grant, loan, or cooperative agreement from using appropriated funds to pay any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with any of the following covered Federal actions: the awarding of any Federal contract; the making of any Federal grant; the making of any Federal loan; the entering into of any cooperative agreement; or the modification of any Federal contract, grant, loan, or cooperative agreement.

(2) The Act also requires Contractors to furnish a disclosure if any funds other than Federal appropriated funds (including profit or fee received under a covered Federal transaction) have been paid, or will be paid, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with a Federal contract, grant, loan, or cooperative agreement.

(3) The prohibitions of the Act do not apply under the following conditions:

(i) Agency and legislative liaison by own employees.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of a payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action if the payment is for agency and legislative liaison activities not directly related to a covered Federal action.

(B) For purposes of subdivision (b)(3)(i)(A) of this clause, providing any information specifically requested by an agency or Congress is permitted at any time.

(C) The following agency and legislative liaison activities are permitted at any time where they are not related to a specific solicitation for any covered Federal action:

(1) Discussing with an agency the qualities and characteristics (including individual demonstrations) of the person's products or services, conditions or terms of sale, and service capabilities.

(2) Technical discussions and other activities regarding the application or adaptation of the person's products or services for an agency's use.

(D) The following agency and legislative liaison activities are permitted where they are prior to formal solicitation of any covered Federal action--

(1) Providing any information not specifically requested but necessary for an agency to make an informed decision about initiation of a covered Federal action;

(2) Technical discussions regarding the preparation of an unsolicited proposal prior to its official submission; and

(3) Capability presentations by persons seeking awards from an agency pursuant to the provisions of the Small Business Act, as amended by Pub. L. 95-507, and subsequent amendments.

(E) Only those services expressly authorized by subdivision (b)(3)(i)(A) of this clause are permitted under this clause.

(ii) Professional and technical services.

(A) The prohibition on the use of appropriated funds, in subparagraph (b)(1) of this clause, does not apply in the case of--

(1) A payment of reasonable compensation made to an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action, if payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action.

(2) Any reasonable payment to a person, other than an officer or employee of a person requesting or receiving a covered Federal action or an extension, continuation, renewal, amendment, or modification of a covered Federal action if the payment is for professional or technical services rendered directly in the preparation, submission, or negotiation of any bid, proposal, or application for that Federal action or for meeting requirements imposed by or pursuant to law as a condition for receiving that Federal action. Persons other than officers or employees of a person requesting or receiving a covered Federal action include consultants and trade associations.

(B) For purposes of subdivision (b)(3)(ii)(A) of this clause, "professional and technical services" shall be limited to advice and analysis directly applying any professional or technical discipline. For example, drafting of a legal document accompanying a bid or proposal by a lawyer is allowable. Similarly, technical advice provided by an engineer on the performance or operational capability of a piece of equipment rendered directly in the negotiation of a contract is allowable. However, communications with the intent to influence made by a professional (such as a licensed lawyer) or a technical person (such as a licensed accountant) are not allowable under this section unless they provide advice and analysis directly applying their professional or technical expertise and unless the advice or analysis is rendered directly and solely in the preparation, submission or negotiation of a covered Federal action. Thus, for example, communications with the intent to influence made by a lawyer that do not provide legal advice or analysis directly and solely related to the legal aspects of his or her client's proposal, but generally advocate one proposal over another are not allowable under this section because the lawyer is not providing professional legal services. Similarly, communications with the intent to influence made by an engineer providing an engineering analysis prior to the preparation or submission of a bid or proposal are not allowable under this section since the engineer is providing technical services but not directly in the preparation, submission or negotiation of a covered Federal action.

(C) Requirements imposed by or pursuant to law as a condition for receiving a covered Federal award include those required by law or regulation and any other requirements in the actual award documents.

(D) Only those services expressly authorized by subdivisions (b)(3)(ii)(A)(1) and (2) of this clause are permitted under this clause.

(E) The reporting requirements of FAR 3.803(a) shall not apply with respect to payments of reasonable compensation made to regularly employed officers or employees of a person.

(c) Disclosure.

(1) The Contractor who requests or receives from an agency a Federal contract shall file with that agency a disclosure form, OMB standard form LLL, Disclosure of Lobbying Activities, if such person has made or has agreed to make any payment using nonappropriated funds (to include profits from any covered Federal action), which would be prohibited under subparagraph (b)(1) of this clause, if paid for with appropriated funds.

(2) The Contractor shall file a disclosure form at the end of each calendar quarter in which there occurs any event that materially affects the accuracy of the information contained in any disclosure form previously filed by such person under subparagraph (c)(1) of this clause. An event that materially affects the accuracy of the information reported includes--

(i) A cumulative increase of \$25,000 or more in the amount paid or expected to be paid for influencing or attempting to influence a covered Federal action; or

(ii) A change in the person(s) or individual(s) influencing or attempting to influence a covered Federal action; or

(iii) A change in the officer(s), employee(s), or Member(s) contacted to influence or attempt to influence a covered Federal action.

(3) The Contractor shall require the submittal of a certification, and if required, a disclosure form by any person who requests or receives any subcontract exceeding \$100,000 under the Federal contract.

(4) All subcontractor disclosure forms (but not certifications) shall be forwarded from tier to tier until received by the prime Contractor. The prime Contractor shall submit all disclosures to the Contracting Officer at the end of the calendar quarter in which the disclosure form is submitted by the subcontractor. Each subcontractor certification shall be retained in the subcontract file of the awarding Contractor.

(d) Agreement. The Contractor agrees not to make any payment prohibited by this clause.

(e) Penalties.

(1) Any person who makes an expenditure prohibited under paragraph (a) of this clause or who fails to file or amend the disclosure form to be filed or amended by paragraph (b) of this clause shall be subject to civil penalties as provided for by 31 U.S.C. 1352. An imposition of a civil penalty does not prevent the Government from seeking any other remedy that may be applicable.

(2) Contractors may rely without liability on the representation made by their subcontractors in the certification and disclosure form.

(f) Cost allowability. Nothing in this clause makes allowable or reasonable any costs which would otherwise be unallowable or unreasonable. Conversely, costs made specifically unallowable by the requirements in this clause will not be made allowable under any other provision.

(End of clause)

52.204-4 PRINTED OR COPIED DOUBLE-SIDED ON RECYCLED PAPER (AUG 2000)

(a) Definitions. As used in this clause--

“Postconsumer material” means a material or finished product that has served its intended use and has been discarded for disposal or recovery, having completed its life as a consumer item. Postconsumer material is a part of the broader category of “recovered material.” For paper and paper products, postconsumer material means “postconsumer fiber” defined by the U.S. Environmental Protection Agency (EPA) as--

(1) Paper, paperboard, and fibrous materials from retail stores, office buildings, homes, and so forth, after they have passed through their end-usage as a consumer item, including: used corrugated boxes; old newspapers; old magazines; mixed waste paper; tabulating cards; and used cordage; or

(2) All paper, paperboard, and fibrous materials that enter and are collected from municipal solid waste; but not

(3) Fiber derived from printers' over-runs, converters' scrap, and over-issue publications.

“Printed or copied double-sided” means printing or reproducing a document so that information is on both sides of a sheet of paper.

“Recovered material,” for paper and paper products, is defined by EPA in its Comprehensive Procurement Guideline as “recovered fiber” and means the following materials:

(1) Postconsumer fiber; and

(2) Manufacturing wastes such as--

(i) Dry paper and paperboard waste generated after completion of the papermaking process (that is, those manufacturing operations up to and including the cutting and trimming of the paper machine reel into smaller rolls or rough sheets) including: envelope cuttings, bindery trimmings, and other paper and paperboard waste resulting from printing, cutting, forming, and other converting operations; bag, box, and carton manufacturing wastes; and butt rolls, mill wrappers, and rejected unused stock; and

(ii) Repulped finished paper and paperboard from obsolete inventories of paper and paperboard manufacturers, merchants, wholesalers, dealers, printers, converters, or others.

(b) In accordance with Section 101 of Executive Order 13101 of September 14, 1998, Greening the Government through Waste Prevention, Recycling, and Federal Acquisition, the Contractor is encouraged to submit paper documents, such as offers, letters, or reports, that are printed or copied double-sided on recycled paper that meet minimum content standards specified in Section 505 of Executive Order 13101, when not using electronic commerce methods to submit information or data to the Government.

(c) If the Contractor cannot purchase high-speed copier paper, offset paper, forms bond, computer printout paper, carbonless paper, file folders, white wove envelopes, writing and office paper, book paper, cotton fiber paper, and cover stock meeting the 30 percent postconsumer material standard for use in submitting paper documents to the Government, it should use paper containing no less than 20 percent postconsumer material. This lesser standard should be used only when paper meeting the 30 percent postconsumer material standard is not obtainable at a reasonable price or does not meet reasonable performance standards.

(End of clause)

52.209-6 PROTECTING THE GOVERNMENT'S INTEREST WHEN SUBCONTRACTING WITH CONTRACTORS DEBARRED, SUSPENDED, OR PROPOSED FOR DEBARMENT (JUL 1995)

(a) The Government suspends or debar Contractors to protect the Government's interests. The Contractor shall not enter into any subcontract in excess of the \$25,000 with a Contractor that is debarred, suspended, or proposed for debarment unless there is a compelling reason to do so.

(b) The Contractor shall require each proposed first-tier subcontractor, whose subcontract will exceed \$25,000, to disclose to the Contractor, in writing, whether as of the time of award of the subcontract, the subcontractor, or its principles, is or is not debarred, suspended, or proposed for debarment by the Federal Government.

(c) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is debarred, suspended, or proposed for debarment (see FAR 9.404 for information on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs). The notice must include the following:

(1) The name of the subcontractor.

(2) The Contractor's knowledge of the reasons for the subcontractor being on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(3) The compelling reason(s) for doing business with the subcontractor notwithstanding its inclusion on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs.

(4) The systems and procedures the Contractor has established to ensure that it is fully protecting the Government's interests when dealing with such subcontractor in view of the specific basis for the party's debarment, suspension, or proposed debarment.

(End of clause)

52.211-13 TIME EXTENSIONS (SEP 2000)

Time extensions for contract changes will depend upon the extent, if any, by which the changes cause delay in the completion of the various elements of construction. The change order granting the time extension may provide that the contract completion date will be extended only for those specific elements related to the changed work and that the remaining contract completion dates for all other portions of the work will not be altered. The change order also may provide an equitable readjustment of liquidated damages under the new completion schedule.

(End of clause)

52.211-18 VARIATION IN ESTIMATED QUANTITY (APR 1984)

If the quantity of a unit-priced item in this contract is an estimated quantity and the actual quantity of the unit-priced item varies more than 15 percent above or below the estimated quantity, an equitable adjustment in the contract price shall be made upon demand of either party. The equitable adjustment shall be based upon any increase or decrease in costs due solely to the variation above 115 percent or below 85 percent of the estimated quantity. If the quantity variation is such as to cause an increase in the time necessary for completion, the Contractor may request, in writing, an extension of time, to be received by the Contracting Officer within 10 days from the beginning of the delay, or within such further period as may be granted by the Contracting Officer before the date of final settlement of the contract. Upon the receipt of a written request for an extension, the Contracting Officer shall ascertain the facts and make an adjustment for extending the completion date as, in the judgement of the Contracting Officer, is justified.

52.212-4007 ENVIRONMENTAL LITIGATION

(a) If the performance of all or any part of the work is suspended, delayed, or interrupted due to an order of a court of competent jurisdiction as a result of environmental litigation, as defined below, the Contracting Officer, at the request of the Contractor, shall determine whether the order is due in any part to the acts or omissions of the Contractor or a Subcontractor at any tier not required by the terms of this contract. If it is determined that the order is not due in any part to acts or omissions of the Contractor or a Subcontractor at any tier other than as required by the terms of this contract, such suspension, delay, or interruption shall be considered as if ordered by the Contracting Officer in the administration of this contract under the terms of the "Suspension of Work" clause of this contract. The period of such suspension, delay or interruption shall be considered unreasonable, and an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) as provided in that clause, subject to all the provisions thereof.

(b) The term "environmental litigation", as used herein, means a lawsuit alleging that the work will have an adverse effect on the environment or that the Government has not duly considered, either substantially or procedurally, the effect of the work on the environment.

52.215-2 AUDIT AND RECORDS--NEGOTIATION (JUN 1999)

(a) As used in this clause, "records" includes books, documents, accounting procedures and practices, and other data, regardless of type and regardless of whether such items are in written form, in the form of computer data, or in any other form.

(b) Examination of costs. If this is a cost-reimbursement, incentive, time-and-materials, labor-hour, or price redeterminable contract, or any combination of these, the Contractor shall maintain and the Contracting Officer, or an authorized representative of the Contracting Officer, shall have the right to examine and audit all records and other evidence sufficient to reflect properly all costs claimed to have been incurred or anticipated to be incurred directly or

indirectly in performance of this contract. This right of examination shall include inspection at all reasonable times of the Contractor's plants, or parts of them, engaged in performing the contract.

(c) Cost or pricing data. If the Contractor has been required to submit cost or pricing data in connection with any pricing action relating to this contract, the Contracting Officer, or an authorized representative of the Contracting Officer, in order to evaluate the accuracy, completeness, and currency of the cost or pricing data, shall have the right to examine and audit all of the Contractor's records, including computations and projections, related to--

- (1) The proposal for the contract, subcontract, or modification;
- (2) The discussions conducted on the proposal(s), including those related to negotiating;
- (3) Pricing of the contract, subcontract, or modification; or
- (4) Performance of the contract, subcontract or modification.

(d) Comptroller General--(1) The Comptroller General of the United States, or an authorized representative, shall have access to and the right to examine any of the Contractor's directly pertinent records involving transactions related to this contract or a subcontract hereunder.

(2) This paragraph may not be construed to require the Contractor or subcontractor to create or maintain any record that the Contractor or subcontractor does not maintain in the ordinary course of business or pursuant to a provision of law.

(e) Reports. If the Contractor is required to furnish cost, funding, or performance reports, the Contracting Officer or an authorized representative of the Contracting Officer shall have the right to examine and audit the supporting records and materials, for the purpose of evaluating (1) the effectiveness of the Contractor's policies and procedures to produce data compatible with the objectives of these reports and (2) the data reported.

(f) Availability. The Contractor shall make available at its office at all reasonable times the records, materials, and other evidence described in paragraphs (a), (b), (c), (d), and (e) of this clause, for examination, audit, or reproduction, until 3 years after final payment under this contract or for any shorter period specified in Subpart 4.7, Contractor Records Retention, of the Federal Acquisition Regulation (FAR), or for any longer period required by statute or by other clauses of this contract. In addition--

- (1) If this contract is completely or partially terminated, the Contractor shall make available the records relating to the work terminated until 3 years after any resulting final termination settlement; and
- (2) The Contractor shall make available records relating to appeals under the Disputes clause or to litigation or the settlement of claims arising under or relating to this contract until such appeals, litigation, or claims are finally resolved.

(g) The Contractor shall insert a clause containing all the terms of this clause, including this paragraph (g), in all subcontracts under this contract that exceed the simplified acquisition threshold, and--

- (1) That are cost-reimbursement, incentive, time-and-materials, labor-hour, or price-redeterminable type or any combination of these;
- (2) For which cost or pricing data are required; or
- (3) That require the subcontractor to furnish reports as discussed in paragraph (e) of this clause.

The clause may be altered only as necessary to identify properly the contracting parties and the Contracting Officer

under the Government prime contract.

(End of clause)

52.215-8 ORDER OF PRECEDENCE--UNIFORM CONTRACT FORMAT (OCT 1997)

Any inconsistency in this solicitation or contract shall be resolved by giving precedence in the following order:

- (a) The Schedule (excluding the specifications).
- (b) Representations and other instructions.
- (c) Contract clauses.
- (d) Other documents, exhibits, and attachments.
- (e) The specifications.

(End of clause)

52.215-11 PRICE REDUCTION FOR DEFECTIVE COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

- (a) This clause shall become operative only for any modification to this contract involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, except that this clause does not apply to any modification if an exception under FAR 15.403-1 applies.
- (b) If any price, including profit or fee, negotiated in connection with any modification under this clause, or any cost reimbursable under this contract, was increased by any significant amount because (1) the Contractor or a subcontractor furnished cost or pricing data that were not complete, accurate, and current as certified in its Certificate of Current Cost or Pricing Data, (2) a subcontractor or prospective subcontractor furnished the Contractor cost or pricing data that were not complete, accurate, and current as certified in the Contractor's Certificate of Current Cost or Pricing Data, or (3) any of these parties furnished data of any description that were not accurate, the price or cost shall be reduced accordingly and the contract shall be modified to reflect the reduction. This right to a price reduction is limited to that resulting from defects in data relating to modifications for which this clause becomes operative under paragraph (a) of this clause.
- (c) Any reduction in the contract price under paragraph (b) of this clause due to defective data from a prospective subcontractor that was not subsequently awarded the subcontract shall be limited to the amount, plus applicable overhead and profit markup, by which--
 - (1) The actual subcontract; or
 - (2) The actual cost to the Contractor, if there was no subcontract, was less than the prospective subcontract cost estimate submitted by the Contractor; provided, that the actual subcontract price was not itself affected by defective cost or pricing data.
- (d)(1) If the Contracting Officer determines under paragraph (b) of this clause that a price or cost reduction should be made, the Contractor agrees not to raise the following matters as a defense:

(i) The Contractor or subcontractor was a sole source supplier or otherwise was in a superior bargaining position and thus the price of the contract would not have been modified even if accurate, complete, and current cost or pricing data had been submitted.

(ii) The Contracting Officer should have known that the cost or pricing data in issue were defective even though the Contractor or subcontractor took no affirmative action to bring the character of the data to the attention of the Contracting Officer.

(iii) The contract was based on an agreement about the total cost of the contract and there was no agreement about the cost of each item procured under the contract.

(iv) The Contractor or subcontractor did not submit a Certificate of Current Cost or Pricing Data.

(2)(i) Except as prohibited by subdivision (d)(2)(ii) of this clause, an offset in an amount determined appropriate by the Contracting Officer based upon the facts shall be allowed against the amount of a contract price reduction if--

(A) The Contractor certifies to the Contracting Officer that, to the best of the Contractor's knowledge and belief, the Contractor is entitled to the offset in the amount requested; and

(B) The Contractor proves that the cost or pricing data were available before the "as of" date specified on its Certificate of Current Cost or Pricing Data, and that the data were not submitted before such date.

(ii) An offset shall not be allowed if--

(A) The understated data were known by the Contractor to be understated before the "as of" date specified on its Certificate of Current Cost or Pricing Data; or

(B) The Government proves that the facts demonstrate that the contract price would not have increased in the amount to be offset even if the available data had been submitted before the "as of" date specified on its Certificate of Current Cost or Pricing Data.

(e) If any reduction in the contract price under this clause reduces the price of items for which payment was made prior to the date of the modification reflecting the price reduction, the Contractor shall be liable to and shall pay the United States at the time such overpayment is repaid--

(1) Simple interest on the amount of such overpayment to be computed from the date(s) of overpayment to the Contractor to the date the Government is repaid by the Contractor at the applicable underpayment rate effective for each quarter prescribed by the Secretary of the Treasury under 26 U.S.C. 6621(a)(2); and

A penalty equal to the amount of the overpayment, if the Contractor or subcontractor knowingly submitted cost or pricing data that were incomplete, inaccurate, or noncurrent.

(End of clause)

52.215-12 SUBCONTRACTOR COST OR PRICING DATA (OCT 1997)

(a) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1 applies.

(b) The Contractor shall require the subcontractor to certify in substantially the form prescribed in FAR 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (a) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

(c) In each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4, when entered into, the Contractor shall insert either--

(1) The substance of this clause, including this paragraph (c), if paragraph (a) of this clause requires submission of cost or pricing data for the subcontract; or

(2) The substance of the clause at FAR 52.215-13, Subcontractor Cost or Pricing Data--Modifications.

52.215-13 SUBCONTRACTOR COST OR PRICING DATA--MODIFICATIONS (OCT 1997)

(a) The requirements of paragraphs (b) and (c) of this clause shall--

(1) Become operative only for any modification to this contract involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4; and

(2) Be limited to such modifications.

(b) Before awarding any subcontract expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, on the date of agreement on price or the date of award, whichever is later; or before pricing any subcontract modification involving a pricing adjustment expected to exceed the threshold for submission of cost or pricing data at FAR 15.403-4, the Contractor shall require the subcontractor to submit cost or pricing data (actually or by specific identification in writing), unless an exception under FAR 15.403-1 applies.

(c) The Contractor shall require the subcontractor to certify in substantially the form prescribed in FAR 15.406-2 that, to the best of its knowledge and belief, the data submitted under paragraph (b) of this clause were accurate, complete, and current as of the date of agreement on the negotiated price of the subcontract or subcontract modification.

The Contractor shall insert the substance of this clause, including this paragraph (d), in each subcontract that exceeds the threshold for submission of cost or pricing data at FAR 15.403-4 on the date of agreement on price or the date of award, whichever is later.

(End of clause)

52.219-4 NOTICE OF PRICE EVALUATION PREFERENCE FOR HUBZONE SMALL BUSINESS CONCERNS (JAN 1999)

(a) Definition. HUBZone small business concern, as used in this clause, means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

(b) Evaluation preference. (1) Offers will be evaluated by adding a factor of 10 percent to the price of all offers, except--

(i) Offers from HUBZone small business concerns that have not waived the evaluation preference;

(ii) Otherwise successful offers from small business concerns;

(iii) Otherwise successful offers of eligible products under the Trade Agreements Act when the dollar threshold for application of the Act is exceeded (see 25.402 of the Federal Acquisition Regulation (FAR)); and

(iv) Otherwise successful offers where application of the factor would be inconsistent with a Memorandum of Understanding or other international agreement with a foreign government.

(2) The factor of 10 percent shall be applied on a line item basis or to any group of items on which award may be made. Other evaluation factors described in the solicitation shall be applied before application of the factor.

(3) A concern that is both a HUBZone small business concern and a small disadvantaged business concern will receive the benefit of both the HUBZone small business price evaluation preference and the small disadvantaged business price evaluation adjustment (see FAR clause 52.219-23). Each applicable price evaluation preference or adjustment shall be calculated independently against an offeror's base offer.

These individual preference amounts shall be added together to arrive at the total evaluated price for that offer.

(c) Waiver of evaluation preference. A HUBZone small business concern may elect to waive the evaluation preference, in which case the factor will be added to its offer for evaluation purposes. The agreements in paragraph (d) of this clause do not apply if the offeror has waived the evaluation preference.

___ Offeror elects to waive the evaluation preference.

(d) Agreement. A HUBZone small business concern agrees that in the performance of the contract, in the case of a contract for

(1) Services (except construction), at least 50 percent of the cost of personnel for contract performance will be spent for employees of the concern or employees of other HUBZone small business concerns;

(2) Supplies (other than procurement from a nonmanufacturer of such supplies), at least 50 percent of the cost of manufacturing, excluding the cost of materials, will be performed by the concern or other HUBZone small business concerns;

(3) General construction, at least 15 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns; or

(4) Construction by special trade contractors, at least 25 percent of the cost of the contract performance incurred for personnel will be spent on the concern's employees or the employees of other HUBZone small business concerns.

(e) A HUBZone joint venture agrees that in the performance of the contract, the applicable percentage specified in paragraph (d) of this clause will be performed by the HUBZone small business participant or participants.

(f) A HUBZone small business concern nonmanufacturer agrees to furnish in performing this contract only end items manufactured or produced by HUBZone small business manufacturer concerns. This paragraph does not apply in connection with construction or service contracts.

(End of clause)

52.219-8 UTILIZATION OF SMALL BUSINESS CONCERNS (OCT 2000)

(a) It is the policy of the United States that small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged

business concerns, and women-owned small business concerns shall have the maximum practicable opportunity to participate in performing contracts let by any Federal agency, including contracts and subcontracts for subsystems, assemblies, components, and related services for major systems. It is further the policy of the United States that its prime contractors establish procedures to ensure the timely payment of amounts due pursuant to the terms of their subcontracts with small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, HUBZone small business concerns, small disadvantaged business concerns, and women-owned small business concerns.

(b) The Contractor hereby agrees to carry out this policy in the awarding of subcontracts to the fullest extent consistent with efficient contract performance. The Contractor further agrees to cooperate in any studies or surveys as may be conducted by the United States Small Business Administration or the awarding agency of the United States as may be necessary to determine the extent of the Contractor's compliance with this clause.

Definitions. As used in this contract--

HUBZone small business concern means a small business concern that appears on the List of Qualified HUBZone Small Business Concerns maintained by the Small Business Administration.

Service-disabled veteran-owned small business concern--

(1) Means a small business concern--

(i) Not less than 51 percent of which is owned by one or more service-disabled veterans or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more service-disabled veterans; and

(ii) The management and daily business operations of which are controlled by one or more service-disabled veterans or, in the case of a veteran with permanent and severe disability, the spouse or permanent caregiver of such veteran.

(2) Service-disabled veteran means a veteran, as defined in 38 U.S.C. 101(2), with a disability that is service-connected, as defined in 38 U.S.C. 101(16).

Small business concern means a small business as defined pursuant to Section 3 of the Small Business Act and relevant regulations promulgated pursuant thereto.

Small disadvantaged business concern means a small business concern that represents, as part of its offer that--

(1) It has received certification as a small disadvantaged business concern consistent with 13 CFR part 124, subpart B;

(2) No material change in disadvantaged ownership and control has occurred since its certification;

(3) Where the concern is owned by one or more individuals, the net worth of each individual upon whom the certification is based does not exceed \$750,000 after taking into account the applicable exclusions set forth at 13 CFR 124.104(c)(2); and

(4) It is identified, on the date of its representation, as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net).

Veteran-owned small business concern means a small business concern--

(1) Not less than 51 percent of which is owned by one or more veterans (as defined at 38 U.S.C. 101(2)) or, in the case of any publicly owned business, not less than 51 percent of the stock of which is owned by one or more veterans; and

(2) The management and daily business operations of which are controlled by one or more veterans.

Women-owned small business concern means a small business concern--

(1) That is at least 51 percent owned by one or more women, or, in the case of any publicly owned business, at least 51 percent of the stock of which is owned by one or more women; and

(2) Whose management and daily business operations are controlled by one or more women.

(d) Contractors acting in good faith may rely on written representations by their subcontractors regarding their status as a small business concern, a veteran-owned small business concern, a service-disabled veteran-owned small business concern, a HUBZone small business concern, a small disadvantaged business concern, or a women-owned small business concern.

(End of clause)

52.219-9 SMALL BUSINESS SUBCONTRACTING PLAN (JAN 2002)--ALTERNATE II (OCT 2001).

(a) This clause does not apply to small business concerns.

(b) Definitions. As used in this clause--

Commercial item means a product or service that satisfies the definition of commercial item in section 2.101 of the Federal Acquisition Regulation.

Commercial plan means a subcontracting plan (including goals) that covers the offeror's fiscal year and that applies to the entire production of commercial items sold by either the entire company or a portion thereof (e.g., division, plant, or product line).

Individual contract plan means a subcontracting plan that covers the entire contract period (including option periods), applies to a specific contract, and has goals that are based on the offeror's planned subcontracting in support of the specific contract, except that indirect costs incurred for common or joint purposes may be allocated on a prorated basis to the contract.

Master plan means a subcontracting plan that contains all the required elements of an individual contract plan, except goals, and may be incorporated into individual contract plans, provided the master plan has been approved.

Subcontract means any agreement (other than one involving an employer-employee relationship) entered into by a Federal Government prime Contractor or subcontractor calling for supplies or services required for performance of the contract or subcontract.

(c) Proposals submitted in response to this solicitation shall include a subcontracting plan that separately addresses subcontracting with small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns. If the offeror is submitting an individual contract plan, the plan must separately address subcontracting with small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns, with a separate part for the basic contract and separate parts for each option (if any). The plan shall be included in and made a part of the

resultant contract. The subcontracting plan shall be negotiated within the time specified by the Contracting Officer. Failure to submit and negotiate a subcontracting plan shall make the offeror ineligible for award of a contract.

(d) The offeror's subcontracting plan shall include the following:

(1) Goals, expressed in terms of percentages of total planned subcontracting dollars, for the use of small business, veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns as subcontractors. The offeror shall include all subcontracts that contribute to contract performance, and may include a proportionate share of products and services that are normally allocated as indirect costs.

(2) A statement of--

(i) Total dollars planned to be subcontracted for an individual contract plan; or the offeror's total projected sales, expressed in dollars, and the total value of projected subcontracts to support the sales for a commercial plan;

(ii) Total dollars planned to be subcontracted to small business concerns;

(iii) Total dollars planned to be subcontracted to veteran-owned small business concerns;

(iv) Total dollars planned to be subcontracted to HUBZone small business concerns;

(v) Total dollars planned to be subcontracted to small disadvantaged business concerns; and

(vi) Total dollars planned to be subcontracted to women-owned small business concerns.

(3) A description of the principal types of supplies and services to be subcontracted, and an identification of the types planned for subcontracting to--

(i) Small business concerns;

(ii) Veteran-owned small business concerns;

(iii) HUBZone small business concerns;

(iv) Small disadvantaged business concerns; and

(v) Women-owned small business concerns.

(4) A description of the method used to develop the subcontracting goals in paragraph (d)(1) of this clause.

(5) A description of the method used to identify potential sources for solicitation purposes (e.g., existing company source lists, the Procurement Marketing and Access Network (PRO-Net) of the Small Business Administration (SBA), veterans service organizations, the National Minority Purchasing Council Vendor Information Service, the Research and Information Division of the Minority Business Development Agency in the Department of Commerce, or small, HUBZone, small disadvantaged, and women-owned small business trade associations). A firm may rely on the information contained in PRO-Net as an accurate representation of a concern's size and ownership characteristics for the purposes of maintaining a small, veteran-owned small, HUBZone small, small disadvantaged, and women-owned small business source list. Use of PRO-Net as its source list does not relieve a firm of its responsibilities (e.g., outreach, assistance, counseling, or publicizing subcontracting opportunities) in this clause.

(6) A statement as to whether or not the offeror included indirect costs in establishing subcontracting goals, and a description of the method used to determine the proportionate share of indirect costs to be incurred with—

- (i) Small business concerns;
- (ii) Veteran-owned small business concerns;
- (iii) HUBZone small business concerns;
- (iv) Small disadvantaged business concerns; and
- (v) Women-owned small business concerns.

(7) The name of the individual employed by the offeror who will administer the offeror's subcontracting program, and a description of the duties of the individual.

(8) A description of the efforts the offeror will make to assure that small business, veteran-owned small business, HUBZone small business, small disadvantaged business and women-owned small business concerns have an equitable opportunity to compete for subcontracts.

(9) Assurances that the offeror will include the clause of this contract entitled "Utilization of Small Business Concerns" in all subcontracts that offer further subcontracting opportunities, and that the offeror will require all subcontractors (except small business concerns) that receive subcontracts in excess of \$500,000 (\$1,000,000 for construction of any public facility) to adopt a subcontracting plan that complies with the requirements of this clause.

(10) Assurances that the offeror will--

- (i) Cooperate in any studies or surveys as may be required;
- (ii) Submit periodic reports so that the Government can determine the extent of compliance by the offeror with the subcontracting plan;
- (iii) Submit Standard Form (SF) 294, Subcontracting Report for Individual Contracts, and/or SF 295, Summary Subcontract Report, in accordance with paragraph (j) of this clause. The reports shall provide information on subcontract awards to small business concerns, veteran-owned small business concerns, service-disabled veteran-owned small business concerns, small disadvantaged business concerns, women-owned small business concerns, and Historically Black Colleges and Universities and Minority Institutions. Reporting shall be in accordance with the instructions on the forms or as provided in agency regulations.
- (iv) Ensure that its subcontractors agree to submit SF 294 and SF 295.

(11) A description of the types of records that will be maintained concerning procedures that have been adopted to comply with the requirements and goals in the plan, including establishing source lists; and a description of the offeror's efforts to locate small business, veteran-owned small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns and award subcontracts to them. The records shall include at least the following (on a plant-wide or company-wide basis, unless otherwise indicated)

- (i) Source lists (e.g., PRO-Net), guides, and other data that identify small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns.
- (ii) Organizations contacted in an attempt to locate sources that are small business, veteran-owned small business, HUBZone small business, small disadvantaged business, or women-owned small business concerns.
- (iii) Records on each subcontract solicitation resulting in an award of more than \$100,000, indicating--

- (A) Whether small business concerns were solicited and, if not, why not;
 - (B) Whether veteran-owned small business concerns were solicited and, if not, why not;
 - (C) Whether HUBZone small business concerns were solicited and, if not, why not;
 - (D) Whether small disadvantaged business concerns were solicited and, if not, why not;
 - (E) Whether women-owned small business concerns were solicited and, if not, why not; and
 - (F) If applicable, the reason award was not made to a small business concern.
- (iv) Records of any outreach efforts to contact--
- (A) Trade associations;
 - (B) Business development organizations;
 - (C) Conferences and trade fairs to locate small, HUBZone small, small disadvantaged, and women-owned small business sources; and
 - (D) Veterans service organizations.
- (v) Records of internal guidance and encouragement provided to buyers through--
- (A) Workshops, seminars, training, etc.; and
 - (B) Monitoring performance to evaluate compliance with the program's requirements.
- (vi) On a contract-by-contract basis, records to support award data submitted by the offeror to the Government, including the name, address, and business size of each subcontractor. Contractors having commercial plans need not comply with this requirement.
- (e) In order to effectively implement this plan to the extent consistent with efficient contract performance, the Contractor shall perform the following functions:
- (1) Assist small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns by arranging solicitations, time for the preparation of bids, quantities, specifications, and delivery schedules so as to facilitate the participation by such concerns. Where the Contractor's lists of potential small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business subcontractors are excessively long, reasonable effort shall be made to give all such small business concerns an opportunity to compete over a period of time.
 - (2) Provide adequate and timely consideration of the potentialities of small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business concerns in all "make-or-buy" decisions.
 - (3) Counsel and discuss subcontracting opportunities with representatives of small business, veteran-owner small business, HUBZone small business, small disadvantaged business, and women-owned small business firms.
 - (4) Provide notice to subcontractors concerning penalties and remedies for misrepresentations of business status as small, veteran-owner small business, HUBZone small, small disadvantaged, or women-owned small business for the

purpose of obtaining a subcontract that is to be included as part or all of a goal contained in the Contractor's subcontracting plan.

(f) A master plan on a plant or division-wide basis that contains all the elements required by paragraph (d) of this clause, except goals, may be incorporated by reference as a part of the subcontracting plan required of the offeror by this clause; provided--

(1) the master plan has been approved, (2) the offeror ensures that the master plan is updated as necessary and provides copies of the approved master plan, including evidence of its approval, to the Contracting Officer, and (3) goals and any deviations from the master plan deemed necessary by the Contracting Officer to satisfy the requirements of this contract are set forth in the individual subcontracting plan.

(g) A commercial plan is the preferred type of subcontracting plan for contractors furnishing commercial items. The commercial plan shall relate to the offeror's planned subcontracting generally, for both commercial and Government business, rather than solely to the Government contract. Commercial plans are also preferred for subcontractors that provide commercial items under a prime contract, whether or not the prime contractor is supplying a commercial item.

(h) Prior compliance of the offeror with other such subcontracting plans under previous contracts will be considered by the Contracting Officer in determining the responsibility of the offeror for award of the contract.

(i) The failure of the Contractor or subcontractor to comply in good faith with (1) the clause of this contract entitled "Utilization Of Small Business Concerns," or (2) an approved plan required by this clause, shall be a material breach of the contract.

(j) The Contractor shall submit the following reports:

(1) Standard Form 294, Subcontracting Report for Individual Contracts. This report shall be submitted to the Contracting Officer semiannually and at contract completion. The report covers subcontract award data related to this contract. This report is not required for commercial plans.

(2) Standard Form 295, Summary Subcontract Report. This report encompasses all of the contracts with the awarding agency. It must be submitted semi-annually for contracts with the Department of Defense and annually for contracts with civilian agencies. If the reporting activity is covered by a commercial plan, the reporting activity must report annually all subcontract awards under that plan. All reports submitted at the close of each fiscal year (both individual and commercial plans) shall include a breakout, in the Contractor's format, of subcontract awards, in whole dollars, to small disadvantaged business concerns by North American Industry Classification System (NAICS) Industry Subsector. For a commercial plan, the Contractor may obtain from each of its subcontractors a predominant NAICS Industry Subsector and report all awards to that subcontractor under its predominant NAICS Industry Subsector.

(End of clause)

52.219-16 LIQUIDATED DAMAGES-SUBCONTRACTING PLAN (JAN 1999)

(a) Failure to make a good faith effort to comply with the subcontracting plan, as used in this clause, means a willful or intentional failure to perform in accordance with the requirements of the subcontracting plan approved under the clause in this contract entitled "Small Business Subcontracting Plan," or willful or intentional action to frustrate the plan.

(b) Performance shall be measured by applying the percentage goals to the total actual subcontracting dollars or, if a commercial plan is involved, to the pro rata share of actual subcontracting dollars attributable to Government contracts covered by the commercial plan. If, at contract completion or, in the case of a commercial plan, at the close of the fiscal year for which the plan is applicable, the Contractor has failed to meet its subcontracting goals and the

Contracting Officer decides in accordance with paragraph (c) of this clause that the Contractor failed to make a good faith effort to comply with its subcontracting plan, established in accordance with the clause in this contract entitled "Small Business Subcontracting Plan," the Contractor shall pay the Government liquidated damages in an amount stated. The amount of probable damages attributable to the Contractor's failure to comply shall be an amount equal to the actual dollar amount by which the Contractor failed to achieve each subcontract goal.

(c) Before the Contracting Officer makes a final decision that the Contractor has failed to make such good faith effort, the Contracting Officer shall give the Contractor written notice specifying the failure and permitting the Contractor to demonstrate what good faith efforts have been made and to discuss the matter. Failure to respond to the notice may be taken as an admission that no valid explanation exists. If, after consideration of all the pertinent data, the Contracting Officer finds that the Contractor failed to make a good faith effort to comply with the subcontracting plan, the Contracting Officer shall issue a final decision to that effect and require that the Contractor pay the Government liquidated damages as provided in paragraph (b) of this clause.

(d) With respect to commercial plans, the Contracting Officer who approved the plan will perform the functions of the Contracting Officer under this clause on behalf of all agencies with contracts covered by the commercial plan.

(e) The Contractor shall have the right of appeal, under the clause in this contract entitled Disputes, from any final decision of the Contracting Officer.

(f) Liquidated damages shall be in addition to any other remedies that the Government may have.

(End of clause)

52.219-25 SMALL DISADVANTAGED BUSINESS PARTICIPATION PROGRAM—DISADVANTAGED STATUS AND REPORTING (OCT 1999)

(a) Disadvantaged status for joint venture partners, team members, and subcontractors. This clause addresses disadvantaged status for joint venture partners, teaming arrangement members, and subcontractors and is applicable if this contract contains small disadvantaged business (SDB) participation targets. The Contractor shall obtain representations of small disadvantaged status from joint venture partners, teaming arrangement members, and subcontractors through use of a provision substantially the same as paragraph (b)(1)(i) of the provision at FAR 52.219-22, Small Disadvantaged Business Status. The Contractor shall confirm that a joint venture partner, team member, or subcontractor representing itself as a small disadvantaged business concern, is identified as a certified small disadvantaged business in the database maintained by the Small Business Administration (PRO-Net) or by contacting the SBA's Office of Small Disadvantaged Business Certification and Eligibility.

(b) Reporting requirement. If this contract contains SDB participation targets, the Contractor shall report on the participation of SDB concerns at contract completion, or as otherwise provided in this contract. Reporting may be on Optional Form 312, Small Disadvantaged Business Participation Report, or in the Contractor's own format providing the same information. This report is required for each contract containing SDB participation targets. If this contract contains an individual Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, reports may be submitted with the final Subcontracting Report for Individual Contracts (Standard Form 294) at the completion of the contract.

(End of clause)

52.222-1 NOTICE TO THE GOVERNMENT OF LABOR DISPUTES (FEB 1997)

If the Contractor has knowledge that any actual or potential labor dispute is delaying or threatens to delay the timely performance of this contract, the Contractor shall immediately give notice, including all relevant information, to the

Contracting Officer.

(End of clause)

52.222-3 CONVICT LABOR (AUG 1996)

The Contractor agrees not to employ in the performance of this contract any person undergoing a sentence of imprisonment which has been imposed by any court of a State, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands. This limitation, however, shall not prohibit the employment by the Contractor in the performance of this contract of persons on parole or probation to work at paid employment during the term of their sentence or persons who have been pardoned or who have served their terms. Nor shall it prohibit the employment by the Contractor in the performance of this contract of persons confined for violation of the laws of any of the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or the Trust Territory of the Pacific Islands who are authorized to work at paid employment in the community under the laws of such jurisdiction, if--

- (a)(1) The worker is paid or is in an approved work training program on a voluntary basis;
- (2) Representatives of local union central bodies or similar labor union organizations have been consulted;
- (3) Such paid employment will not result in the displacement of employed workers, or be applied in skills, crafts, or trades in which there is a surplus of available gainful labor in the locality, or impair existing contracts for services; and
- (4) The rates of pay and other conditions of employment will not be less than those paid or provided for work of a similar nature in the locality in which the work is being performed; and
- (b) The Attorney General of the United States has certified that the work-release laws or regulations of the jurisdiction involved are in conformity with the requirements of Executive Order 11755, as amended by Executive Orders 12608 and 12943.

(End of clause)

52.222-4 CONTRACT WORK HOURS AND SAFETY STANDARDS ACT - OVERTIME COMPENSATION. (SEP 2000)

- (a) Overtime requirements. No Contractor or subcontractor employing laborers or mechanics (see Federal Acquisition Regulation 22.300) shall require or permit them to work over 40 hours in any workweek unless they are paid at least 1 and 1/2 times the basic rate of pay for each hour worked over 40 hours.
- (b) Violation; liability for unpaid wages; liquidated damages. The responsible Contractor and subcontractor are liable for unpaid wages if they violate the terms in paragraph (a) of this clause. In addition, the Contractor and subcontractor are liable for liquidated damages payable to the Government. The Contracting Officer will assess liquidated damages at the rate of \$10 per affected employee for each calendar day on which the employer required or permitted the employee to work in excess of the standard workweek of 40 hours without paying overtime wages required by the Contract Work Hours and Safety Standards Act.
- (c) Withholding for unpaid wages and liquidated damages. The Contracting Officer will withhold from payments due under the contract sufficient funds required to satisfy any Contractor or subcontractor liabilities for unpaid wages

and liquidated damages. If amounts withheld under the contract are insufficient to satisfy Contractor or subcontractor liabilities, the Contracting Officer will withhold payments from other Federal or Federally assisted contracts held by the same Contractor that are subject to the Contract Work Hours and Safety Standards Act.

(d) Payrolls and basic records.

(1) The Contractor and its subcontractors shall maintain payrolls and basic payroll records for all laborers and mechanics working on the contract during the contract and shall make them available to the Government until 3 years after contract completion. The records shall contain the name and address of each employee, social security number, labor classifications, hourly rates of wages paid, daily and weekly number of hours worked, deductions made, and actual wages paid. The records need not duplicate those required for construction work by Department of Labor regulations at 29 CFR 5.5(a)(3) implementing the Davis-Bacon Act.

(2) The Contractor and its subcontractors shall allow authorized representatives of the Contracting Officer or the Department of Labor to inspect, copy, or transcribe records maintained under paragraph (d)(1) of this clause. The Contractor or subcontractor also shall allow authorized representatives of the Contracting Officer or Department of Labor to interview employees in the workplace during working hours.

(e) Subcontracts. The Contractor shall insert the provisions set forth in paragraphs (a) through (d) of this clause in subcontracts exceeding \$100,000 and require subcontractors to include these provisions in any lower tier subcontracts. The Contractor shall be responsible for compliance by any subcontractor or lower-tier subcontractor with the provisions set forth in paragraphs (a) through (d) of this clause.

(End of clause)

52.222-6 DAVIS-BACON ACT (FEB 1995)

(a) All laborers and mechanics employed or working upon the site of the work will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR Part 3), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor and such laborers and mechanics. Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (d) of this clause; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such period. Such laborers and mechanics shall be paid not less than the appropriate wage rate and fringe benefits in the wage determination for the classification of work actually performed, without regard to skill, except as provided in the clause entitled Apprentices and Trainees. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; provided, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (b) of this clause) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the Contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(b)(1) The Contracting Officer shall require that any class of laborers or mechanics which is not listed in the wage determination and which is to be employed under the contract shall be classified in conformance with the wage determination. The Contracting Officer shall approve an additional classification and wage rate and fringe benefits

therefor only when all the following criteria have been met:

- (i) The work to be performed by the classification requested is not performed by a classification in the wage determination.
 - (ii) The classification is utilized in the area by the construction industry.
 - (iii) The proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
- (2) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the Contracting Officer agree on the classification and wage rate (including the amount designated for fringe benefits, where appropriate), a report of the action taken shall be sent by the Contracting Officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator or an authorized representative will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.
- (3) In the event the Contractor, the laborers or mechanics to be employed in the classification, or their representatives, and the Contracting Officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the Contracting Officer shall refer the questions, including the views of all interested parties and the recommendation of the Contracting Officer, to the Administrator of the Wage and Hour Division for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the Contracting Officer or will notify the Contracting Officer within the 30-day period that additional time is necessary.
- (4) The wage rate (including fringe benefits, where appropriate) determined pursuant to subparagraphs (b)(2) and (b)(3) of this clause shall be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.
- (c) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the Contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.
- (3) If the Contractor does not make payments to a trustee or other third person, the Contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program; provided, That the Secretary of Labor has found, upon the written request of the Contractor, that the applicable standards of the Davis -Bacon Act have been met. The Secretary of Labor may require the Contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

(End of clause)

52.222-7 WITHHOLDING OF FUNDS (FEB 1988)

The Contracting Officer shall, upon his or her own action or upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the Contractor under this contract or any other Federal contract with the same Prime Contractor, or any other Federally assisted contract subject to Davis -Bacon prevailing wage requirements, which is held by the same Prime Contractor, so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the Contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on

the site of the work, all or part of the wages required by the contract, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(End of clause)

52.222-8 PAYROLLS AND BASIC RECORDS (FEB 1988)

(a) Payrolls and basic records relating thereto shall be maintained by the Contractor during the course of the work and preserved for a period of 3 years thereafter for all laborers and mechanics working at the site of the work. Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made, and actual wages paid. Whenever the Secretary of Labor has found, under paragraph (d) of the clause entitled Davis-Bacon Act, that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the Contractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(b)(1) The Contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the Contracting Officer. The payrolls submitted shall set out accurately and completely all of the information required to be maintained under paragraph (a) of this clause. This information may be submitted in any form desired. Optional Form WH-347 (Federal Stock Number 029-005-00014-1) is available for this purpose and may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402. The Prime Contractor is responsible for the submission of copies of payrolls by all subcontractors.

(2) Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the Contractor or subcontractor or his or her agent who pays or supervises the payment of the persons employed under the contract and shall certify--

(i) That the payroll for the payroll period contains the information required to be maintained under paragraph (a) of this clause and that such information is correct and complete;

(ii) That each laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR Part 3; and

(iii) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

(3) The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by subparagraph (b)(2) of this clause.

(4) The falsification of any of the certifications in this clause may subject the Contractor or subcontractor to civil or criminal prosecution under Section 1001 of Title 18 and Section 3729 of Title 31 of the United States Code.

(c) The Contractor or subcontractor shall make the records required under paragraph (a) of this clause available for inspection, copying, or transcription by the Contracting Officer or authorized representatives of the Contracting Officer or the Department of Labor. The Contractor or subcontractor shall permit the Contracting Officer or representatives of the Contracting Officer or the Department of Labor to interview employees during working hours on the job. If the Contractor or subcontractor fails to submit required records or to make them available, the Contracting Officer may, after written notice to the Contractor, take such action as may be necessary to cause the suspension of any further payment. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

(End of clause)

52.222-9 APPRENTICES AND TRAINEES (FEB 1988)

(a) Apprentices. Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State Apprenticeship Agency recognized by the Bureau, or if a person is employed in his or her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice. The allowable ratio of apprentices to journeymen on the job site in any craft classification shall not be greater than the ratio permitted to the Contractor as to the entire work force under the registered program. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in this paragraph, shall be paid not less than the applicable wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman's hourly rate) specified in the Contractor's or subcontractor's registered program shall be observed. Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination. In the event the Bureau of Apprenticeship and Training, or a State Apprenticeship Agency recognized by the Bureau, withdraws approval of an apprenticeship program, the Contractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(b) Trainees. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed in the wage determination unless the Administrator of the Wage and Hour

Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate in the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate in the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate in the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the Contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(c) Equal employment opportunity. The utilization of apprentices, trainees, and journeymen under this clause shall be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(End of clause)

52.222-10 COMPLIANCE WITH COPELAND ACT REQUIREMENTS (FEB 1988)

The Contractor shall comply with the requirements of 29 CFR Part 3, which are hereby incorporated by reference in this contract.

(End of clause)

52.222-11 SUBCONTRACTS (LABOR STANDARDS (FEB 1988)

(a) The Contractor or subcontractor shall insert in any subcontracts the clauses entitled Davis -Bacon Act, Contract Work Hours and Safety Standards Act-Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Withholding of Funds, Subcontracts (Labor Standards), Contract Termination-Debarment, Disputes Concerning Labor Standards, Compliance with Davis -Bacon and Related Act Regulations, and Certification of Eligibility, and such other clauses as the Contracting Officer may, by appropriate instructions, require, and also a clause requiring subcontractors to include these clauses in any lower tier subcontracts. The Prime Contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with all the contract clauses cited in this paragraph.

(b)(1) Within 14 days after award of the contract, the Contractor shall deliver to the Contracting Officer a completed Statement and Acknowledgment Form (SF 1413) for each subcontract, including the subcontractor's signed and dated acknowledgment that the clauses set forth in paragraph (a) of this clause have been included in the subcontract.

(iii) Within 14 days after the award of any subsequently awarded subcontract the Contractor shall deliver to the Contracting Officer an updated completed SF 1413 for such additional subcontract.

(End of clause)

52.222-12 CONTRACT TERMINATION--DEBARMENT (FEB 1988)

A breach of the contract clauses entitled Davis -Bacon Act, Contract Work Hours and Safety Standards Act--

Overtime Compensation, Apprentices and Trainees, Payrolls and Basic Records, Compliance with Copeland Act Requirements, Subcontracts (Labor Standards), Compliance with Davis -Bacon and Related Act Regulations, or Certification of Eligibility may be grounds for termination of the contract, and for debarment as a Contractor and subcontractor as provided in 29 CFR 5.12.

(End of clause)

52.222-13 COMPLIANCE WITH DAVIS-BACON AND RELATED ACT REGULATIONS (FEB 1988)

All rulings and interpretations of the Davis -Bacon and Related Acts contained in 29 CFR Parts 1, 3, and 5 are hereby incorporated by reference in this contract.

(End of clause)

52.222-14 DISPUTES CONCERNING LABOR STANDARDS (FEB 1988)

The United States Department of Labor has set forth in 29 CFR Parts 5, 6, and 7 procedures for resolving disputes concerning labor standards requirements. Such disputes shall be resolved in accordance with those procedures and not the Disputes clause of this contract. Disputes within the meaning of this clause include disputes between the Contractor (or any of its subcontractors) and the contracting agency, the U.S. Department of Labor, or the employees or their representatives.

(End of clause)

52.222-15 CERTIFICATION OF ELIGIBILITY (FEB 1988)

(a) By entering into this contract, the Contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the Contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis -Bacon Act or 29 CFR 5.12(a)(1).

(b) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of section 3(a) of the Davis -Bacon Act or 29 CFR 5.12(a)(1).

(4) The penalty for making false statements is prescribed in the U.S. Criminal Code, 18 U.S.C. 1001.

(End of clause)

52.222-21 PROHIBITION OF SEGREGATED FACILITIES (FEB 1999)

(a) Segregated facilities, as used in this clause, means any waiting rooms, work areas, rest rooms and wash rooms, restaurants and other eating areas, time clocks, locker rooms and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees, that are segregated by explicit directive or are in fact segregated on the basis of race, color, religion, sex, or national origin because of written or oral policies or employee custom. The term does not include separate or single-user rest rooms or necessary dressing or sleeping areas provided to assure privacy between the sexes.

(b) The Contractor agrees that it does not and will not maintain or provide for its employees any segregated facilities at any of its establishments, and that it does not and will not permit its employees to perform their services at any location under its control where segregated facilities are maintained. The Contractor agrees that a breach of this clause is a violation of the Equal Opportunity clause in this contract.

(c) The Contractor shall include this clause in every subcontract and purchase order that is subject to the Equal Opportunity clause of this contract.

(End of clause)

52.222-23 NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY FOR CONSTRUCTION (FEB 1999)

(a) The offeror's attention is called to the Equal Opportunity clause and the Affirmative Action Compliance Requirements for Construction clause of this solicitation.

(b) The goals for minority and female participation, expressed in percentage terms for the Contractor's aggregate workforce in each trade on all construction work in the covered area, are as follows:

Goals for minority participation for each trade	Goals for female participation for each trade
6.2%	6.9%

These goals are applicable to all the Contractor's construction work performed in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, the Contractor shall apply the goals established for the geographical area where the work is actually performed. Goals are published periodically in the Federal Register in notice form, and these notices may be obtained from any Office of Federal Contract Compliance Programs office.

(c) The Contractor's compliance with Executive Order 11246, as amended, and the regulations in 41 CFR 60-4 shall be based on (1) its implementation of the Equal Opportunity clause, (2) specific affirmative action obligations required by the clause entitled "Affirmative Action Compliance Requirements for Construction," and (3) its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade. The Contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor, or from project to project, for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, Executive Order 11246, as amended, and the regulations in 41 CFR 60-4. Compliance with the goals will be measured against the total work hours performed.

(d) The Contractor shall provide written notification to the Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, within 10 working days following award of any construction subcontract in excess of \$10,000 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the --

(1) Name, address, and telephone number of the subcontractor;

(2) Employer's identification number of the subcontractor;

- (3) Estimated dollar amount of the subcontract;
- (4) Estimated starting and completion dates of the subcontract; and
- (5) Geographical area in which the subcontract is to be performed.
- (e) As used in this Notice, and in any contract resulting from this solicitation, the "covered area" is Tacoma (Fort Lewis), Pierce County, Washington,
(End of provision)

52.222-26 EQUAL OPPORTUNITY (APR 2002)

- (a) Definition. United States, as used in this clause, means the 50 States, the District of Columbia, Puerto Rico, the Northern Mariana Islands, American Samoa, Guam, the U.S. Virgin Islands, and Wake Island.
- (b) If, during any 12-month period (including the 12 months preceding the award of this contract), the Contractor has been or is awarded nonexempt Federal contracts and/or subcontracts that have an aggregate value in excess of \$10,000, the Contractor shall comply with paragraphs (b)(1) through (b)(11) of this clause, except for work performed outside the United States by employees who were not recruited within the United States. Upon request, the Contractor shall provide information necessary to determine the applicability of this clause.
 - (1) The Contractor shall not discriminate against any employee or applicant for employment because of race, color, religion, sex, or national origin. However, it shall not be a violation of this clause for the Contractor to extend a publicly announced preference in employment to Indians living on or near an Indian reservation, in connection with employment opportunities on or near an Indian reservation, as permitted by 41 CFR 60-1.5.
 - (2) The Contractor shall take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their race, color, religion, sex, or national origin. This shall include, but not be limited to, (i) employment, (ii) upgrading, (iii) demotion, (iv) transfer, (v) recruitment or recruitment advertising, (vi) layoff or termination, (vii) rates of pay or other forms of compensation, and (viii) selection for training, including apprenticeship.
 - (3) The Contractor shall post in conspicuous places available to employees and applicants for employment the notices to be provided by the Contracting Officer that explain this clause.
 - (4) The Contractor shall, in all solicitations or advertisements for employees placed by or on behalf of the Contractor, state that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, or national origin.
 - (5) The Contractor shall send, to each labor union or representative of workers with which it has a collective bargaining agreement or other contract or understanding, the notice to be provided by the Contracting Officer advising the labor union or workers' representative of the Contractor's commitments under this clause, and post copies of the notice in conspicuous places available to employees and applicants for employment.
 - (6) The Contractor shall comply with Executive Order 11246, as amended, and the rules, regulations, and orders of the Secretary of Labor.
 - (7) The Contractor shall furnish to the contracting agency all information required by Executive Order 11246, as amended, and by the rules, regulations, and orders of the Secretary of Labor. The Contractor shall also file Standard Form 100 (EEO-1), or any successor form, as prescribed in 41 CFR part 60-1. Unless the Contractor has filed within the

12 months preceding the date of contract award, the Contractor shall, within 30 days after contract award, apply to either the regional Office of Federal Contract Compliance Programs (OFCCP) or the local office of the Equal Employment Opportunity Commission for the necessary forms.

(8) The Contractor shall permit access to its premises, during normal business hours, by the contracting agency or the OFCCP for the purpose of conducting on-site compliance evaluations and complaint investigations. The Contractor shall permit the Government to inspect and copy any books, accounts, records (including computerized records), and other material that may be relevant to the matter under investigation and pertinent to compliance with Executive Order 11246, as amended, and rules and regulations that implement the Executive Order.

(9) If the OFCCP determines that the Contractor is not in compliance with this clause or any rule, regulation, or order of the Secretary of Labor, this contract may be canceled, terminated, or suspended in whole or in part and the Contractor may be declared ineligible for further Government contracts, under the procedures authorized in Executive Order 11246, as amended. In addition, sanctions may be imposed and remedies invoked against the Contractor as provided in Executive Order 11246, as amended; in the rules, regulations, and orders of the Secretary of Labor; or as otherwise provided by law.

(10) The Contractor shall include the terms and conditions of subparagraphs (b)(1) through (11) of this clause in every subcontract or purchase order that is not exempted by the rules, regulations, or orders of the Secretary of Labor issued under Executive Order 11246, as amended, so that these terms and conditions will be binding upon each subcontractor or vendor.

(11) The Contractor shall take such action with respect to any subcontract or purchase order as the contracting officer may direct as a means of enforcing these terms and conditions, including sanctions for noncompliance; provided, that if the Contractor becomes involved in, or is threatened with, litigation with a subcontractor or vendor as a result of any direction, the Contractor may request the United States to enter into the litigation to protect the interests of the United States.

(c) Notwithstanding any other clause in this contract, disputes relative to this clause will be governed by the procedures in 41 CFR 60-1.1.

(End of clause)

52.222-27 AFFIRMATIVE ACTION COMPLIANCE REQUIREMENTS FOR CONSTRUCTION (FEB 1999)

(a) Definitions. "Covered area," as used in this clause, means the geographical area described in the solicitation for this contract.

"Deputy Assistant Secretary," as used in this clause, means Deputy Assistant Secretary for Federal Contract Compliance, U.S. Department of Labor, or a designee.

"Employer's identification number," as used in this clause, means the Federal Social Security number used on the employer's quarterly federal tax return, U.S. Treasury Department Form 941.

"Minority," as used in this clause, means--

(1) American Indian or Alaskan Native (all persons having origins in any of the original peoples of North America and maintaining identifiable tribal affiliations through membership and participation or community identification).

(2) Asian and Pacific Islander (all persons having origins in any of the original peoples of the Far East, Southeast Asia, the Indian Subcontinent, or the Pacific Islands);

(3) Black (all persons having origins in any of the black African racial groups not of Hispanic origin); and

(4) Hispanic (all persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

(b) If the Contractor, or a subcontractor at any tier, subcontracts a portion of the work involving any construction trade, each such subcontract in excess of \$10,000 shall include this clause and the Notice containing the goals for minority and female participation stated in the solicitation for this contract.

(c) If the Contractor is participating in a Hometown Plan (41 CFR 60-4) approved by the U.S. Department of Labor in a covered area, either individually or through an association, its affirmative action obligations on all work in the plan area (including goals) shall comply with the plan for those trades that have unions participating in the plan. Contractors must be able to demonstrate participation in, and compliance with, the provisions of the plan. Each Contractor or subcontractor participating in an approved plan is also required to comply with its obligations under the Equal Opportunity clause, and to make a good faith effort to achieve each goal under the plan in each trade in which it has employees. The overall good-faith performance by other Contractors or subcontractors toward a goal in an approved plan does not excuse any Contractor's or subcontractor's failure to make good-faith efforts to achieve the plan's goals.

(d) The Contractor shall implement the affirmative action procedures in subparagraphs (g)(1) through (16) of this clause. The goals stated in the solicitation for this contract are expressed as percentages of the total hours of employment and training of minority and female utilization that the Contractor should reasonably be able to achieve in each construction trade in which it has employees in the covered area. If the Contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for the geographical area where that work is actually performed. The Contractor is expected to make substantially uniform progress toward its goals in each craft.

(e) Neither the terms and conditions of any collective bargaining agreement, nor the failure by a union with which the Contractor has a collective bargaining agreement, to refer minorities or women shall excuse the Contractor's obligations under this clause, Executive Order 11246, as amended, or the regulations thereunder.

(f) In order for the nonworking training hours of apprentices and trainees to be counted in meeting the goals, apprentices and trainees must be employed by the Contractor during the training period, and the Contractor must have made a commitment to employ the apprentices and trainees at the completion of their training, subject to the availability of employment opportunities. Trainees must be trained pursuant to training programs approved by the U.S. Department of Labor.

(g) The Contractor shall take affirmative action to ensure equal employment opportunity. The evaluation of the Contractor's compliance with this clause shall be based upon its effort to achieve maximum results from its actions. The Contractor shall document these efforts fully and implement affirmative action steps at least as extensive as the following:

(1) Ensure a working environment free of harassment, intimidation, and coercion at all sites and in all facilities where the Contractor's employees are assigned to work. The Contractor, if possible, will assign two or more women to each construction project. The Contractor shall ensure that foremen, superintendents, and other onsite supervisory personnel are aware of and carry out the Contractor's obligation to maintain such a working environment, with specific attention to minority or female individuals working at these sites or facilities.

(2) Establish and maintain a current list of sources for minority and female recruitment. Provide written notification to minority and female recruitment sources and community organizations when the Contractor or its unions have employment opportunities available, and maintain a record of the organizations' responses.

(3) Establish and maintain a current file of the names, addresses, and telephone numbers of each minority and female off-the-street applicant, referrals of minorities or females from unions, recruitment sources, or community organizations, and the action taken with respect to each individual. If an individual was sent to the union hiring hall for referral and not referred back to the Contractor by the union or, if referred back, not employed by the Contractor, this shall be documented in the file, along with whatever additional actions the Contractor may have taken.

(4) Immediately notify the Deputy Assistant Secretary when the union or unions with which the Contractor has a collective bargaining agreement has not referred back to the Contractor a minority or woman sent by the Contractor, or when the Contractor has other information that the union referral process has impeded the Contractor's efforts to meet its obligations.

(5) Develop on-the-job training opportunities and/or participate in training programs for the area that expressly include minorities and women, including upgrading programs and apprenticeship and trainee programs relevant to the Contractor's employment needs, especially those programs funded or approved by the Department of Labor. The Contractor shall provide notice of these programs to the sources compiled under subparagraph (g)(2) of this clause.

(6) Disseminate the Contractor's equal employment policy by--

(i) Providing notice of the policy to unions and to training, recruitment, and outreach programs, and requesting their cooperation in assisting the Contractor in meeting its contract obligations;

(ii) Including the policy in any policy manual and in collective bargaining agreements;

(iii) Publicizing the policy in the company newspaper, annual report, etc.;

(iv) Reviewing the policy with all management personnel and with all minority and female employees at least once a year; and

(v) Posting the policy on bulletin boards accessible to employees at each location where construction work is performed.

(7) Review, at least annually, the Contractor's equal employment policy and affirmative action obligations with all employees having responsibility for hiring, assignment, layoff, termination, or other employment decisions. Conduct review of this policy with all on-site supervisory personnel before initiating construction work at a job site. A written record shall be made and maintained identifying the time and place of these meetings, persons attending, subject matter discussed, and disposition of the subject matter.

(8) Disseminate the Contractor's equal employment policy externally by including it in any advertising in the news media, specifically including minority and female news media. Provide written notification to, and discuss this policy with, other Contractors and subcontractors with which the Contractor does or anticipates doing business.

(9) Direct recruitment efforts, both oral and written, to minority, female, and community organizations, to schools with minority and female students, and to minority and female recruitment and training organizations serving the Contractor's recruitment area and employment needs. Not later than 1 month before the date for acceptance of applications for apprenticeship or training by any recruitment source, send written notification to organizations such as the above, describing the openings, screening procedures, and tests to be used in the selection process.

(10) Encourage present minority and female employees to recruit minority persons and women. Where reasonable, provide after-school, summer, and vacation employment to minority and female youth both on the site and in other areas of the Contractor's workforce.

(11) Validate all tests and other selection requirements where required under 41 CFR 60-3.

(12) Conduct, at least annually, an inventory and evaluation at least of all minority and female personnel for promotional opportunities. Encourage these employees to seek or to prepare for, through appropriate training, etc., opportunities for promotion.

(13) Ensure that seniority practices, job classifications, work assignments, and other personnel practices do not have a discriminatory effect by continually monitoring all personnel and employment-related activities to ensure that the Contractor's obligations under this contract are being carried out.

(14) Ensure that all facilities and company activities are nonsegregated except that separate or single-user rest rooms and necessary dressing or sleeping areas shall be provided to assure privacy between the sexes.

(15) Maintain a record of solicitations for subcontracts for minority and female construction contractors and suppliers, including circulation of solicitations to minority and female contractor associations and other business associations.

(16) Conduct a review, at least annually, of all supervisors' adherence to and performance under the Contractor's equal employment policy and affirmative action obligations.

(h) The Contractor is encouraged to participate in voluntary associations that may assist in fulfilling one or more of the affirmative action obligations contained in subparagraphs (g)(1) through (16) of this clause. The efforts of a contractor association, joint contractor-union, contractor-community, or similar group of which the contractor is a member and participant may be asserted as fulfilling one or more of its obligations under subparagraphs (g)(1) through (16) of this clause, provided the Contractor--

(1) Actively participates in the group;

(2) Makes every effort to ensure that the group has a positive impact on the employment of minorities and women in the industry;

(3) Ensures that concrete benefits of the program are reflected in the Contractor's minority and female workforce participation;

(4) Makes a good-faith effort to meet its individual goals and timetables; and

(5) Can provide access to documentation that demonstrates the effectiveness of actions taken on behalf of the Contractor. The obligation to comply is the Contractor's, and failure of such a group to fulfill an obligation shall not be a defense for the Contractor's noncompliance.

(i) A single goal for minorities and a separate single goal for women shall be established. The Contractor is required to provide equal employment opportunity and to take affirmative action for all minority groups, both male and female, and all women, both minority and nonminority. Consequently, the Contractor may be in violation of Executive Order 11246, as amended, if a particular group is employed in a substantially disparate manner.

(j) The Contractor shall not use goals or affirmative action standards to discriminate against any person because of race, color, religion, sex, or national origin.

(k) The Contractor shall not enter into any subcontract with any person or firm debarred from Government contracts under Executive Order 11246, as amended.

(l) The Contractor shall carry out such sanctions and penalties for violation of this clause and of the Equal Opportunity clause, including suspension, termination, and cancellation of existing subcontracts, as may be imposed or ordered under Executive Order 11246, as amended, and its implementing regulations, by the OFCCP. Any failure to

carry out these sanctions and penalties as ordered shall be a violation of this clause and Executive Order 11246, as amended.

(m) The Contractor in fulfilling its obligations under this clause shall implement affirmative action procedures at least as extensive as those prescribed in paragraph (g) of this clause, so as to achieve maximum results from its efforts to ensure equal employment opportunity. If the Contractor fails to comply with the requirements of Executive Order 11246, as amended, the implementing regulations, or this clause, the Deputy Assistant Secretary shall take action as prescribed in 41 CFR 60-4.8.

(n) The Contractor shall designate a responsible official to--

(1) Monitor all employment-related activity to ensure that the Contractor's equal employment policy is being carried out;

(2) Submit reports as may be required by the Government; and

(3) Keep records that shall at least include for each employee the name, address, telephone number, construction trade, union affiliation (if any), employee identification number, social security number, race, sex, status (e.g., mechanic, apprentice, trainee, helper, or laborer), dates of changes in status, hours worked per week in the indicated trade, rate of pay, and locations at which the work was performed. Records shall be maintained in an easily understandable and retrievable form; however, to the degree that existing records satisfy this requirement, separate records are not required to be maintained.

Nothing contained herein shall be construed as a limitation upon the application of other laws that establish different standards of compliance or upon the requirements for the hiring of local or other area residents (e.g., those under the Public Works Employment Act of 1977 and the Community Development Block Grant Program).

(End of clause)

52.222-35 EQUAL OPPORTUNITY FOR SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) Definitions. As used in this clause--

All employment openings means all positions except executive and top management, those positions that will be filled from within the Contractor's organization, and positions lasting 3 days or less. This term includes full-time employment, temporary employment of more than 3 days duration, and part-time employment.

Executive and top management means any employee--

(1) Whose primary duty consists of the management of the enterprise in which the individual is employed or of a customarily recognized department or subdivision thereof;

(2) Who customarily and regularly directs the work of two or more other employees;

(3) Who has the authority to hire or fire other employees or whose suggestions and recommendations as to the hiring or firing and as to the advancement and promotion or any other change of status of other employees will be given particular weight;

(4) Who customarily and regularly exercises discretionary powers; and

(5) Who does not devote more than 20 percent or, in the case of an employee of a retail or service establishment, who does not devote more than 40 percent of total hours of work in the work week to activities that are not directly and closely related to the performance of the work described in paragraphs (1) through (4) of this definition. This paragraph (5) does not apply in the case of an employee who is in sole charge of an establishment or a physically separated branch establishment, or who owns at least a 20 percent interest in the enterprise in which the individual is employed.

Other eligible veteran means any other veteran who served on active duty during a war or in a campaign or expedition for which a campaign badge has been authorized.

Positions that will be filled from within the Contractor's organization means employment openings for which the Contractor will give no consideration to persons outside the Contractor's organization (including any affiliates, subsidiaries, and parent companies) and includes any openings the Contractor proposes to fill from regularly established "recall" lists. The exception does not apply to a particular opening once an employer decides to consider applicants outside of its organization.

Qualified special disabled veteran means a special disabled veteran who satisfies the requisite skill, experience, education, and other job-related requirements of the employment position such veteran holds or desires, and who, with or without reasonable accommodation, can perform the essential functions of such position.

Special disabled veteran means--

(1) A veteran who is entitled to compensation (or who but for the receipt of military retired pay would be entitled to compensation) under laws administered by the Department of Veterans Affairs for a disability--

(i) Rated at 30 percent or more; or

(ii) Rated at 10 or 20 percent in the case of a veteran who has been determined under 38 U.S.C. 3106 to have a serious employment handicap (i.e., a significant impairment of the veteran's ability to prepare for, obtain, or retain employment consistent with the veteran's abilities, aptitudes, and interests); or

(2) A person who was discharged or released from active duty because of a service-connected disability.

Veteran of the Vietnam era means a person who--

(1) Served on active duty for a period of more than 180 days and was discharged or released from active duty with other than a dishonorable discharge, if any part of such active duty occurred--

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases; or

(2) Was discharged or released from active duty for a service-connected disability if any part of the active duty was performed--

(i) In the Republic of Vietnam between February 28, 1961, and May 7, 1975; or

(ii) Between August 5, 1964, and May 7, 1975, in all other cases.

(b) General. (1) The Contractor shall not discriminate against the individual because the individual is a special disabled veteran, a veteran of the Vietnam era, or other eligible veteran, regarding any position for which the employee or applicant for employment is qualified. The Contractor shall take affirmative action to employ, advance in employment, and otherwise treat qualified special disabled veterans, veterans of the Vietnam era, and other eligible veterans without discrimination based upon their disability or veterans' status in all employment practices such as--

- (i) Recruitment, advertising, and job application procedures;
- (ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff and rehiring;
- (iii) Rate of pay or any other form of compensation and changes in compensation;
- (iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;
- (v) Leaves of absence, sick leave, or any other leave;
- (vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;
- (vii) Selection and financial support for training, including apprenticeship, and on-the-job training under 38 U.S.C. 3687, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;
- (viii) Activities sponsored by the Contractor including social or recreational programs; and
- (ix) Any other term, condition, or privilege of employment.

(2) The Contractor shall comply with the rules, regulations, and relevant orders of the Secretary of Labor issued under the Vietnam Era Veterans' Readjustment Assistance Act of 1972 (the Act), as amended (38 U.S.C. 4211 and 4212).

(c) Listing openings. (1) The Contractor shall immediately list all employment openings that exist at the time of the execution of this contract and those which occur during the performance of this contract, including those not generated by this contract, and including those occurring at an establishment of the Contractor other than the one where the contract is being performed, but excluding those of independently operated corporate affiliates, at an appropriate local public employment service office of the State wherein the opening occurs. Listing employment openings with the U.S. Department of Labor's America's Job Bank shall satisfy the requirement to list jobs with the local employment service office.

(2) The Contractor shall make the listing of employment openings with the local employment service office at least concurrently with using any other recruitment source or effort and shall involve the normal obligations of placing a bona fide job order, including accepting referrals of veterans and nonveterans. This listing of employment openings does not require hiring any particular job applicant or hiring from any particular group of job applicants and is not intended to relieve the Contractor from any requirements of Executive orders or regulations concerning nondiscrimination in employment.

(3) Whenever the Contractor becomes contractually bound to the listing terms of this clause, it shall advise the State public employment agency in each State where it has establishments of the name and location of each hiring location in the State. As long as the Contractor is contractually bound to these terms and has so advised the State agency, it need not advise the State agency of subsequent contracts. The Contractor may advise the State agency when it is no longer bound by this contract clause.

(d) Applicability. This clause does not apply to the listing of employment openings that occur and are filled outside the 50 States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, American Samoa, Guam, the Virgin Islands of the United States, and Wake Island.

(e) Postings. (1) The Contractor shall post employment notices in conspicuous places that are available to employees and applicants for employment.

(2) The employment notices shall--

(i) State the rights of applicants and employees as well as the Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified employees and applicants who are special disabled veterans, veterans of the Vietnam era, and other eligible veterans; and

(ii) Be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance Programs, Department of Labor (Deputy Assistant Secretary of Labor), and provided by or through the Contracting Officer.

(3) The Contractor shall ensure that applicants or employees who are special disabled veterans are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled veteran, or may lower the posted notice so that it can be read by a person in a wheelchair).

(4) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement, or other contract understanding, that the Contractor is bound by the terms of the Act and is committed to take affirmative action to employ, and advance in employment, qualified special disabled veterans, veterans of the Vietnam era, and other eligible veterans.

(f) Noncompliance. If the Contractor does not comply with the requirements of this clause, the Government may take appropriate actions under the rules, regulations, and relevant orders of the Secretary of Labor issued pursuant to the Act.

(g) Subcontracts. The Contractor shall insert the terms of this clause in all subcontracts or purchase orders of \$25,000 or more unless exempted by rules, regulations, or orders of the Secretary of Labor. The Contractor shall act as specified by the Deputy Assistant Secretary of Labor to enforce the terms, including action for noncompliance.

(End of clause)

52.222-36 AFFIRMATIVE ACTION FOR WORKERS WITH DISABILITIES (JUN 1998)

(a) General. (1) Regarding any position for which the employee or applicant for employment is qualified, the Contractor shall not discriminate against any employee or applicant because of physical or mental disability. The Contractor agrees to take affirmative action to employ, advance in employment, and otherwise treat qualified individuals with disabilities without discrimination based upon their physical or mental disability in all employment practices such as--

(i) Recruitment, advertising, and job application procedures;

(ii) Hiring, upgrading, promotion, award of tenure, demotion, transfer, layoff, termination, right of return from layoff, and rehiring;

(iii) Rates of pay or any other form of compensation and changes in compensation;

(iv) Job assignments, job classifications, organizational structures, position descriptions, lines of progression, and seniority lists;

(v) Leaves of absence, sick leave, or any other leave;

- (vi) Fringe benefits available by virtue of employment, whether or not administered by the Contractor;
- (vii) Selection and financial support for training, including apprenticeships, professional meetings, conferences, and other related activities, and selection for leaves of absence to pursue training;
- (viii) Activities sponsored by the Contractor, including social or recreational programs; and
- (ix) Any other term, condition, or privilege of employment.

(2) The Contractor agrees to comply with the rules, regulations, and relevant orders of the Secretary of Labor (Secretary) issued under the Rehabilitation Act of 1973 (29 U.S.C. 793) (the Act), as amended.

(b) Postings. (1) The Contractor agrees to post employment notices stating--

(i) The Contractor's obligation under the law to take affirmative action to employ and advance in employment qualified individuals with disabilities; and

(ii) The rights of applicants and employees.

(2) These notices shall be posted in conspicuous places that are available to employees and applicants for employment. The Contractor shall ensure that applicants and employees with disabilities are informed of the contents of the notice (e.g., the Contractor may have the notice read to a visually disabled individual, or may lower the posted notice so that it might be read by a person in a wheelchair). The notices shall be in a form prescribed by the Deputy Assistant Secretary for Federal Contract Compliance of the U.S. Department of Labor (Deputy Assistant Secretary) and shall be provided by or through the Contracting Officer.

(3) The Contractor shall notify each labor union or representative of workers with which it has a collective bargaining agreement or other contract understanding, that the Contractor is bound by the terms of Section 503 of the Act and is committed to take affirmative action to employ, and advance in employment, qualified individuals with physical or mental disabilities.

(c) Noncompliance. If the Contractor does not comply with the requirements of this clause, appropriate actions may be taken under the rules, regulations, and relevant orders of the Secretary issued pursuant to the Act.

(d) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order in excess of \$10,000 unless exempted by rules, regulations, or orders of the Secretary. The Contractor shall act as specified by the Deputy Assistant Secretary to enforce the terms, including action for noncompliance.

(End of clause)

52.222-37 EMPLOYMENT REPORTS ON SPECIAL DISABLED VETERANS, VETERANS OF THE VIETNAM ERA, AND OTHER ELIGIBLE VETERANS (DEC 2001)

(a) Unless the Contractor is a State or local government agency, the Contractor shall report at least annually, as required by the Secretary of Labor, on--

(1) The number of disabled veterans and the number of veterans of the Vietnam era in the workforce of the contractor by job category and hiring location; and

(2) The total number of new employees hired during the period covered by the report, and of that total, the number of disabled veterans, and the number of veterans of the Vietnam era.

(b) The above items shall be reported by completing the form entitled "Federal Contractor Veterans' Employment Report VETS-100."

(c) Reports shall be submitted no later than September 30 of each year beginning September 30, 1988.

(d) The employment activity report required by paragraph (a)(2) of this clause shall reflect total hires during the most recent 12-month period as of the ending date selected for the employment profile report required by paragraph (a)(1) of this clause. Contractors may select an ending date: (1) As of the end of any pay period during the period January through March 1st of the year the report is due, or (2) as of December 31, if the contractor has previous written approval from the Equal Employment Opportunity Commission to do so for purposes of submitting the Employer Information Report EEO-1 (Standard Form 100).

(e) The count of veterans reported according to paragraph (a) of this clause shall be based on voluntary disclosure. Each Contractor subject to the reporting requirements at 38 U.S.C. 4212 shall invite all disabled veterans and veterans of the Vietnam era who wish to benefit under the affirmative action program at 38 U.S.C. 4212 to identify themselves to the Contractor. The invitation shall state that the information is voluntarily provided; that the information will be kept confidential; that disclosure or refusal to provide the information will not subject the applicant or employee to any adverse treatment; and that the information will be used only in accordance with the regulations promulgated under 38 U.S.C. 4212.

(f) Subcontracts. The Contractor shall include the terms of this clause in every subcontract or purchase order of \$10,000 or more unless exempted by rules, regulations, or orders of the Secretary.

(End of clause)

52.223-5 POLLUTION PREVENTION AND RIGHT-TO-KNOW INFORMATION (APR 1998)

(a) Executive Order 12856 of August 3, 1993, requires Federal facilities to comply with the provisions of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA)(42 U.S.C. 11001-11050) and the Pollution Prevention Act of 1990 (PPA)(42 U.S.C. 13101-13109).

(b) The Contractor shall provide all information needed by the Federal facility to comply with the emergency planning reporting requirements of Section 302 of EPCRA; the emergency notice requirements of Section 304 of EPCRA; the list of Material Safety Data Sheets required by Section 311 of EPCRA; the emergency and hazardous chemical inventory forms of Section 312 of EPCRA; the toxic chemical release inventory of Section 313 of EPCRA, which includes the reduction and recycling information required by Section 6607 of PPA; and the toxic chemical reduction goals requirements of Section 3-302 of Executive Order 12856.

(End of clause)

52.223-6 DRUG-FREE WORKPLACE (MAY 2001)

(a) Definitions. As used in this clause --

"Controlled substance" means a controlled substance in schedules I through V of section 202 of the Controlled Substances Act (21 U.S.C. 812) and as further defined in regulation at 21 CFR 1308.11 - 1308.15.

"Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

"Criminal drug statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of any controlled substance.

"Drug-free workplace" means the site(s) for the performance of work done by the Contractor in connection with a specific contract at which employees of the Contractor are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

"Employee" means an employee of a Contractor directly engaged in the performance of work under a Government contract. "Directly engaged" is defined to include all direct cost employees and any other Contractor employee who has other than a minimal impact or involvement in contract performance.

"Individual" means an offeror/contractor that has no more than one employee including the offeror/contractor.

(b) The Contractor, if other than an individual, shall-- within 30 days after award (unless a longer period is agreed to in writing for contracts of 30 days or more performance duration), or as soon as possible for contracts of less than 30 days performance duration--

(1) Publish a statement notifying its employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition;

(2) Establish an ongoing drug-free awareness program to inform such employees about--

(i) The dangers of drug abuse in the workplace;

(ii) The Contractor's policy of maintaining a drug-free workplace;

(iii) Any available drug counseling, rehabilitation, and employee assistance programs; and

(iv) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(3) Provide all employees engaged in performance of the contract with a copy of the statement required by subparagraph (b)(1) of this clause;

(4) Notify such employees in writing in the statement required by subparagraph (b)(1) of this clause that, as a condition of continued employment on this contract, the employee will--

(i) Abide by the terms of the statement; and

(ii) Notify the employer in writing of the employee's conviction under a criminal drug statute for a violation occurring in the workplace no later than 5 days after such conviction.

(5) Notify the Contracting Officer in writing within 10 days after receiving notice under subdivision (b)(4)(ii) of this clause, from an employee or otherwise receiving actual notice of such conviction. The notice shall include the position title of the employee;

(6) Within 30 days after receiving notice under subdivision (b)(4)(ii) of this clause of a conviction, take one of the following actions with respect to any employee who is convicted of a drug abuse violation occurring in the workplace:

(i) Taking appropriate personnel action against such employee, up to and including termination; or

(ii) Require such employee to satisfactorily participate in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency; and

(7) Make a good faith effort to maintain a drug-free workplace through implementation of subparagraphs (b)(1) through (b)(6) of this clause.

(c) The Contractor, if an individual, agrees by award of the contract or acceptance of a purchase order, not to engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance while performing this contract.

(d) In addition to other remedies available to the Government, the Contractor's failure to comply with the requirements of paragraph (b) or (c) of this clause may, pursuant to FAR 23.506, render the Contractor subject to suspension of contract payments, termination of the contract for default, and suspension or debarment.

(End of clause)

52.223-14 TOXIC CHEMICAL RELEASE REPORTING (OCT 2000)

(a) Unless otherwise exempt, the Contractor, as owner or operator of a facility used in the performance of this contract, shall file by July 1 for the prior calendar year an annual Toxic Chemical Release Inventory Form (Form R) as described in sections 313(a) and (g) of the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) (42 U.S.C. 11023(a) and (g)), and section 6607 of the Pollution Prevention Act of 1990 (PPA) (42 U.S.C. 13106). The Contractor shall file, for each facility subject to the Form R filing and reporting requirements, the annual Form R throughout the life of the contract.

(b) A Contractor owned or operated facility used in the performance of this contract is exempt from the requirement to file an annual Form R if--

(1) The facility does not manufacture, process, or otherwise use any toxic chemicals listed under section 313(c) of EPCRA, 42 U.S.C. 11023(c);

(2) The facility does not have 10 or more full-time employees as specified in section 313(b)(1)(A) of EPCRA, 42 U.S.C. 11023(b)(1)(A);

(3) The facility does not meet the reporting thresholds of toxic chemicals established under of EPCRA, 42 U.S.C. 11023(f) (including the alternate thresholds at 40 CFR 372.27, provided an appropriate certification form has been filed with EPA);

(4) The facility does not fall within Standard Industrial Classification Code (SIC) major groups 20 through 39 or their corresponding North American Industry Classification System (NAICS) sectors 31 through 33; or

(5) The facility is not located within any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, Guam, American Samoa, the United States Virgin Islands, the Northern Mariana Islands, or any other territory or possession over which the United States has jurisdiction.

(c) If the Contractor has certified to an exemption in accordance with one or more of the criteria in paragraph (b) of this clause, and after award of the contract circumstances change so that any of its owned or operated facilities used in the performance of this contract is no longer exempt--

(1) The Contractor shall notify the Contracting Officer; and

(2) The Contractor, as owner or operator of a facility used in the performance of this contract that is no longer exempt, shall (i) submit a Toxic Chemical Release Inventory Form (Form R) on or before July 1 for the prior calendar year during which the facility becomes eligible; and (ii) continue to file the annual Form R for the life of the contract for such facility.

(d) The Contracting Officer may terminate this contract or take other action as appropriate, if the Contractor fails to comply accurately and fully with the EPCRA and PPA toxic chemical release filing and reporting requirements.

(e) Except for acquisitions of commercial items, as defined in FAR Part 2, the Contractor shall--

(1) For competitive subcontracts expected to exceed \$100,000 (including all options), include a solicitation provision substantially the same as the provision at FAR 52.223-13, Certification of Toxic Chemical Release Reporting; and

(2) Include in any resultant subcontract exceeding \$100,000 (including all options), the substance of this clause, except this paragraph (e).

(End of clause)

52.225-5 TRADE AGREEMENTS (DEC 2001)

(a) Definitions. As used in this clause.

Caribbean Basin country means any of the following countries: Antigua and Barbuda, Aruba, Bahamas, Barbados, Belize, British Virgin Islands, Costa Rica, Dominica, El Salvador, Grenada, Guatemala, Guyana, Haiti, Jamaica, Montserrat, Netherlands Antilles, Nicaragua, Panama, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Trinidad and Tobago.

Caribbean Basin country end product means an article that--

(1) Is wholly the growth, product, or manufacture of a Caribbean Basin country; or

(2) In the case of an article that consists in whole or in part of materials from another country, has been substantially transformed in a Caribbean Basin country into a new and different article of commerce with a name, character, or use distinct from that of the article or articles from which it was transformed. The term refers to a product offered for purchase under a supply contract, but for purposes of calculating the value of the end product includes services (except transportation services) incidental to the article, provided that the value of those incidental services does not exceed that of the article itself. The term excludes products that are excluded from duty-free treatment for Caribbean countries under 19 U.S.C. 2703(b), which presently are--

(i) Textiles and apparel articles that are subject to textile agreements;

(ii) Footwear, handbags, luggage, flat goods, work gloves, and leather wearing apparel not designated as eligible articles for the purpose of the Generalized System of Preferences under Title V of the Trade Act of 1974;

(iii) Tuna, prepared or preserved in any manner in airtight containers;

(iv) Petroleum, or any product derived from petroleum; and

(v) Watches and watch parts (including cases, bracelets, and straps) of whatever type including, but not limited to, mechanical, quartz digital, or quartz analog, if such watches or watch parts contain any material that is the product of any country to which the Harmonized Tariff Schedule of the United States (HTSUS) column 2 rates of duty apply.

Designated country means any of the following countries: Aruba, Austria, Bangladesh, Belgium, Benin, Bhutan, Botswana, Burkina Faso, Burundi, Canada, Cape Verde, Central African Republic, Chad, Comoros, Denmark, Djibouti, Equatorial Guinea.

Finland, France, Gambia, Germany, Greece, Guinea, Guinea-Bissau, Haiti, Hong Kong, Iceland, Ireland, Israel, Italy, Japan.

Kiribati, Korea, Republic of Lesotho, Liechtenstein, Luxembourg, Malawi, Maldives, Mali, Mozambique, Nepal, Netherlands, Niger, Norway, Portugal, Rwanda.

Sao Tome and Principe, Sierra Leone, Singapore, Somalia, Spain, Sweden, Switzerland, Tanzania U.R., Togo, Tuvalu, Uganda, United Kingdom, Vanuatu, Western Samoa, Yemen.

Designated country end product means an article that--

- (1) Is wholly the growth, product, or manufacture of a designated country; or
- (2) In the case of an article that consists in whole or in part of materials from another country, has been substantially transformed in a designated country into a new and different article of commerce with a name, character, or use distinct from that of the article or articles from which it was transformed. The term refers to a product offered for purchase under a supply contract, but for purposes of calculating the value of the end product includes services, (except transportation services) incidental to the article, provided that the value of those incidental services does not exceed that of the article itself.

End product means supplies delivered under a line item of a Government contract.

North American Free Trade Agreement country means Canada or Mexico.

North American Free Trade Agreement country end product means an article that--

- (1) Is wholly the growth, product, or manufacture of a North American Free Trade Agreement (NAFTA) country; or
- (2) In the case of an article that consists in whole or in part of materials from another country, has been substantially transformed in a NAFTA country into a new and different article of commerce with a name, character, or use distinct from that of the article or articles from which it was transformed. The term refers to a product offered for purchase under a supply contract, but for purposes of calculating the value of the end product includes services, (except transportation services) incidental to the article, provided that the value of those incidental services does not exceed that of the article itself.

United States means the 50 States and the District of Columbia, U.S. territories and possessions, Puerto Rico, the Northern Mariana Islands, and any other place subject to U.S. jurisdiction, but does not include leased bases.

U.S.-made end product means an article that is mined, produced, or manufactured in the United States or that is substantially transformed in the United States into a new and different article of commerce with a name, character, or use distinct from that of the article or articles from which it was transformed.,

(b) Implementation. This clause implements the Trade, Agreements Act (19 U.S.C. 2501, et seq.) and the North American Free Trade Agreement Implementation Act of 1993, (NAFTA) (19 U.S.C. 3301 note), by restricting the acquisition of end products that are not U.S.-made, designated country, Caribbean Basin country, or NAFTA country end products.,

(c) Delivery of end products. The Contracting Officer has determined that the Trade Agreements Act and NAFTA apply to this acquisition. Unless otherwise specified, these trade agreements apply to all items in the Schedule. The Contractor shall deliver under this contract only U.S.-made, designated country, Caribbean Basin country, or NAFTA country end products except to the extent that, in its offer, it specified delivery of other end products in the provision entitled "Trade Agreements Certificate."

(End of clause)

52.225-11 BUY AMERICAN ACT--CONSTRUCTION MATERIALS UNDER TRADE AGREEMENTS (JUL 2002)

(a) Definitions. As used in this clause--

Component means an article, material, or supply incorporated directly into a construction material.

Construction material means an article, material, or supply brought to the construction site by the Contractor or subcontractor for incorporation into the building or work. The term also includes an item brought to the site preassembled from articles, materials, or supplies. However, emergency life safety systems, such as emergency lighting, fire alarm, and audio evacuation systems, that are discrete systems incorporated into a public building or work and that are produced as complete systems, are evaluated as a single and distinct construction material regardless of when or how the individual parts or components of those systems are delivered to the construction site. Materials purchased directly by the Government are supplies, not construction material.

Cost of components means--

(1) For components purchased by the Contractor, the acquisition cost, including transportation costs to the place of incorporation into the construction material (whether or not such costs are paid to a domestic firm), and any applicable duty (whether or not a duty-free entry certificate is issued); or

(2) For components manufactured by the Contractor, all costs associated with the manufacture of the component, including transportation costs as described in paragraph (1) of this definition, plus allocable overhead costs, but excluding profit. Cost of components does not include any costs associated with the manufacture of the end product.

Designated country means any of the following countries: Aruba, Austria, Bangladesh, Belgium, Benin, Bhutan, Botswana, Burkina Faso, Burundi, Canada, Cape Verde, Central African Republic, Chad, Comoros, Denmark.

Djibouti, Equatorial Guinea, Finland, France, Gambia, Germany, Greece, Guinea, Guinea-Bissau, Haiti, Hong Kong, Ireland, Israel, Italy, Japan.

Kiribati, Korea, Republic of, Lesotho, Liechtenstein, Luxembourg, Malawi, Maldives, Mali, Mozambique, Nepal, Netherlands, Niger, Norway, Portugal, Rwanda.

Sao Tome and Principe, Sierra Leone, Singapore, Somalia, Spain, Sweden, Switzerland, Tanzania U.R., Togo, Tuvalu, Uganda, United Kingdom, Vanuatu, Western Samoa, Yemen.

Designated country construction material means a construction material that--

(1) Is wholly the growth, product, or manufacture of a designated country; or

(2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a designated country into a new and different construction material distinct from the materials from which it was transformed.

Domestic construction material means--

- (1) An unmanufactured construction material mined or produced in the United States; or
- (2) A construction material manufactured in the United States, if the cost of its components mined, produced, or manufactured in the United States exceeds 50 percent of the cost of all its components. Components of foreign origin of the same class or kind for which nonavailability determinations have been made are treated as domestic.

Foreign construction material means a construction material other than a domestic construction material.

North American Free Trade Agreement country means Canada or Mexico.

North American Free Trade Agreement country construction material means a construction material that--

- (1) Is wholly the growth, product, or manufacture of a North American Free Trade Agreement (NAFTA) country; or
- (2) In the case of a construction material that consists in whole or in part of materials from another country, has been substantially transformed in a NAFTA country into a new and different construction material distinct from the materials from which it was transformed.

United States means the 50 States and the District of Columbia, U.S. territories and possessions, Puerto Rico, the Northern Mariana Islands, and any other place subject to U.S. jurisdiction, but does not include leased bases.

(b) Construction materials. (1) This clause implements the Buy American Act (41 U.S.C. 10a-10d) and the Balance of Payments Program by providing a preference for domestic construction material. In addition, the Contracting Officer has determined that the Trade Agreements Act and the North American Free Trade Agreement (NAFTA) apply to this acquisition. Therefore, the Buy American Act restrictions are waived for designated country and NAFTA country construction materials.

(2) The Contractor shall use only domestic, designated country, or NAFTA country construction material in performing this contract, except as provided in paragraphs (b)(3) and (b)(4) of this clause.

(3) The requirement in paragraph (b)(2) of this clause does not apply to the construction materials or components listed by the Government as follows: none

(4) The Contracting Officer may add other foreign construction material to the list in paragraph (b)(3) of this clause if the Government determines that--

(i) The cost of domestic construction material would be unreasonable. The cost of a particular domestic construction material subject to the restrictions of the Buy American Act is unreasonable when the cost of such material exceeds the cost of foreign material by more than 6 percent;

(ii) The application of the restriction of the Buy American Act to a particular construction material would be impracticable or inconsistent with the public interest; or

(iii) The construction material is not mined, produced, or manufactured in the United States in sufficient and reasonably available commercial quantities of a satisfactory quality.

(c) Request for determination of inapplicability of the Buy American Act.

- (1)(i) Any Contractor request to use foreign construction material in accordance with paragraph (b)(4) of this clause shall include adequate information for Government evaluation of the request, including--
- (A) A description of the foreign and domestic construction materials;
 - (B) Unit of measure;
 - (C) Quantity;
 - (D) Price;
 - (E) Time of delivery or availability;
 - (F) Location of the construction project;
 - (G) Name and address of the proposed supplier; and
 - (H) A detailed justification of the reason for use of foreign construction materials cited in accordance with paragraph (b)(3) of this clause.
- (ii) A request based on unreasonable cost shall include a reasonable survey of the market and a completed price comparison table in the format in paragraph (d) of this clause.
- (iii) The price of construction material shall include all delivery costs to the construction site and any applicable duty (whether or not a duty-free certificate may be issued).
- (iv) Any Contractor request for a determination submitted after contract award shall explain why the Contractor could not reasonably foresee the need for such determination and could not have requested the determination before contract award. If the Contractor does not submit a satisfactory explanation, the Contracting Officer need not make a determination.
- (2) If the Government determines after contract award that an exception to the Buy American Act applies and the Contracting Officer and the Contractor negotiate adequate consideration, the Contracting Officer will modify the contract to allow use of the foreign construction material. However, when the basis for the exception is the unreasonable price of a domestic construction material, adequate consideration is not less than the differential established in paragraph (b)(4)(i) of this clause.
- (3) Unless the Government determines that an exception to the Buy American Act applies, use of foreign construction material is noncompliant with the Buy American Act.
- (d) Data. To permit evaluation of requests under paragraph (c) of this clause based on unreasonable cost, the Contractor shall include the following information and any applicable supporting data based on the survey of suppliers:

Foreign and Domestic Construction Materials Price Comparison			
Construction material description	Unit of measure	Quantity	Price (dollars) \1\
Item 1:			
Foreign construction material....
Domestic construction material...
Item 2:			

Foreign construction material....
Domestic construction material....

\1\ Include all delivery costs to the construction site and any applicable duty (whether or not a duty-free entry certificate is issued).
List name, address, telephone number, and contact for suppliers surveyed. Attach copy of response; if oral, attach summary.
Include other applicable supporting information.

(End of clause)

52.225-13 RESTRICTIONS ON CERTAIN FOREIGN PURCHASES (JUL 2000)

- (a) The Contractor shall not acquire, for use in the performance of this contract, any supplies or services originating from sources within, or that were located in or transported from or through, countries whose products are banned from importation into the United States under regulations of the Office of Foreign Assets Control, Department of the Treasury. Those countries are Cuba, Iran, Iraq, Libya, North Korea, Sudan, the territory of Afghanistan controlled by the Taliban, and Serbia (excluding the territory of Kosovo).
- (b) The Contractor shall not acquire for use in the performance of this contract any supplies or services from entities controlled by the government of Iraq.
- (c) The Contractor shall insert this clause, including this paragraph (c), in all subcontracts.

(End of clause)

52.227-1 AUTHORIZATION AND CONSENT (JUL 1995)

- (a) The Government authorizes and consents to all use and manufacture, in performing this contract or any subcontract at any tier, of any invention described in and covered by a United States patent (1) embodied in the structure or composition of any article the delivery of which is accepted by the Government under this contract or (2) used in machinery, tools, or methods whose use necessarily results from compliance by the Contractor or a subcontractor with (i) specifications or written provisions forming a part of this contract or (ii) specific written instructions given by the Contracting Officer directing the manner of performance. The entire liability to the Government for infringement of a patent of the United States shall be determined solely by the provisions of the indemnity clause, if any, included in this contract or any subcontract hereunder (including any lower-tier subcontract), and the Government assumes liability for all other infringement to the extent of the authorization and consent hereinabove granted.
- (b) The Contractor agrees to include, and require inclusion of, this clause, suitably modified to identify the parties, in all subcontracts at any tier for supplies or services (including construction, architect-engineer services, and materials, supplies, models, samples, and design or testing services expected to exceed the simplified acquisition threshold (however, omission of this clause from any subcontract, including those at or below the simplified acquisition threshold, does not affect this authorization and consent.)

(End of clause)

52.227-4 PATENT INDEMNITY--CONSTRUCTION CONTRACTS (APR 1984)

Except as otherwise provided, the Contractor agrees to indemnify the Government and its officers, agents, and employees against liability, including costs and expenses, for infringement upon any United States patent (except a patent issued upon an application that is now or may hereafter be withheld from issue pursuant to a Secrecy Order under 35 U.S.C. 181) arising out of performing this contract or out of the use or disposal by or for the account of the Government of supplies furnished or work performed under this contract.

(End of clause)

52.228-2 ADDITIONAL BOND SECURITY (OCT 1997)

The Contractor shall promptly furnish additional security required to protect the Government and persons supplying labor or materials under this contract if--

- (a) Any surety upon any bond, or issuing financial institution for other security, furnished with this contract becomes unacceptable to the Government.
- (b) Any surety fails to furnish reports on its financial condition as required by the Government;
- (c) The contract price is increased so that the penal sum of any bond becomes inadequate in the opinion of the Contracting Officer; or
- (d) An irrevocable letter of credit (ILC) used as security will expire before the end of the period of required security. If the Contractor does not furnish an acceptable extension or replacement ILC, or other acceptable substitute, at least 30 days before an ILC's scheduled expiration, the Contracting officer has the right to immediately draw on the ILC.

(End of clause)

52.228-11 PLEDGES OF ASSETS (FEB 1992)

(a) Offerors shall obtain from each person acting as an individual surety on a bid guarantee, a performance bond, or a payment bond--

(1) Pledge of assets; and

(2) Standard Form 28, Affidavit of Individual Surety.

(b) Pledges of assets from each person acting as an individual surety shall be in the form of--

(1) Evidence of an escrow account containing cash, certificates of deposit, commercial or Government securities, or other assets described in FAR 28.203-2 (except see 28.203-2(b)(2) with respect to Government securities held in book entry form) and/or;

(2) A recorded lien on real estate. The offeror will be required to provide--

(i) Evidence of title in the form of a certificate of title prepared by a title insurance company approved by the United

States Department of Justice. This title evidence must show fee simple title vested in the surety along with any concurrent owners; whether any real estate taxes are due and payable; and any recorded encumbrances against the property, including the lien filed in favor of the Government as required by FAR 28.203-3(d);

(ii) Evidence of the amount due under any encumbrance shown in the evidence of title;

(iii) A copy of the current real estate tax assessment of the property or a current appraisal dated no earlier than 6 months prior to the date of the bond, prepared by a professional appraiser who certifies that the appraisal has been conducted in accordance with the generally accepted appraisal standards as reflected in the Uniform Standards of Professional Appraisal Practice, as promulgated by the Appraisal Foundation.

(End of clause)

52.228-12 PROSPECTIVE SUBCONTRACTOR REQUESTS FOR BONDS. (OCT 1995)

In accordance with Section 806(a)(3) of Pub. L. 102-190, as amended by Sections 2091 and 8105 of Pub. L. 103-355, upon the request of a prospective subcontractor or supplier offering to furnish labor or material for the performance of this contract for which a payment bond has been furnished to the Government pursuant to the Miller Act, the Contractor shall promptly provide a copy of such payment bond to the requester.

(End of clause)

52.228-14 IRREVOCABLE LETTER OF CREDIT (DEC 1999)

(a) "Irrevocable letter of credit" (ILC), as used in this clause, means a written commitment by a federally insured financial institution to pay all or part of a stated amount of money, until the expiration date of the letter, upon presentation by the Government (the beneficiary) of a written demand therefor. Neither the financial institution nor the offeror/Contractor can revoke or condition the letter of credit.

(b) If the offeror intends to use an ILC in lieu of a bid bond, or to secure other types of bonds such as performance and payment bonds, the letter of credit and letter of confirmation formats in paragraphs (e) and (f) of this clause shall be used.

(c) The letter of credit shall be irrevocable, shall require presentation of no document other than a written demand and the ILC (including confirming letter, if any), shall be issued/confirmed by an acceptable federally insured financial institution as provided in paragraph (d) of this clause, and--

(1) If used as a bid guarantee, the ILC shall expire no earlier than 60 days after the close of the bid acceptance period;

(2) If used as an alternative to corporate or individual sureties as security for a performance or payment bond, the offeror/Contractor may submit an ILC with an initial expiration date estimated to cover the entire period for which financial security is required or may submit an ILC with an initial expiration date that is a minimum period of one year from the date of issuance. The ILC shall provide that, unless the issuer provides the beneficiary written notice of non-renewal at least 60 days in advance of the current expiration date, the ILC is automatically extended without amendment for one year from the expiration date, or any future expiration date, until the period of required coverage is completed and the Contracting Officer provides the financial institution with a written statement waiving the right to payment. The period of required coverage shall be:

(i) For contracts subject to the Miller Act, the later of--

(A) One year following the expected date of final payment;

(B) For performance bonds only, until completion of any warranty period; or

(C) For payment bonds only, until resolution of all claims filed against the payment bond during the one-year period following final payment.

(ii) For contracts not subject to the Miller Act, the later of--

(A) 90 days following final payment; or

(B) For performance bonds only, until completion of any warranty period.

(d) Only federally insured financial institutions rated investment grade or higher shall issue or confirm the ILC. The offeror/Contractor shall provide the Contracting Officer a credit rating that indicates the financial institution has the required rating(s) as of the date of issuance of the ILC. Unless the financial institution issuing the ILC had letter of credit business of less than \$25 million in the past year, ILCs over \$5 million must be confirmed by another acceptable financial institution that had letter of credit business of less than \$25 million in the past year.

(e) The following format shall be used by the issuing financial institution to create an ILC:

[Issuing Financial Institution's Letterhead or Name and Address]

Issue Date _____

IRREVOCABLE LETTER OF CREDIT NO. _____

Account party's name _____

Account party's address _____

For Solicitation No. _____ (for reference only)

TO: [U.S. Government agency]

[U.S. Government agency's address]

1. We hereby establish this irrevocable and transferable Letter of Credit in your favor for one or more drawings up to United States \$ _____. This Letter of Credit is payable at [issuing financial institution's and, if any, confirming financial institution's] office at [issuing financial institution's address and, if any, confirming financial institution's address] and expires with our close of business on _____, or any automatically extended expiration date.

2. We hereby undertake to honor your or the transferee's sight draft(s) drawn on the issuing or, if any, the confirming financial institution, for all or any part of this credit if presented with this Letter of Credit and confirmation, if any, at the office specified in paragraph 1 of this Letter of Credit on or before the expiration date or any automatically extended expiration date.

3. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this Letter of Credit that it is deemed to be automatically extended without amendment for one year from the expiration date hereof, or any future expiration date, unless at least 60 days prior to any expiration date, we notify you or the transferee by registered mail, or other receipted means of delivery, that we elect not to consider this Letter of

Credit renewed for any such additional period. At the time we notify you, we also agree to notify the account party (and confirming financial institution, if any) by the same means of delivery.

4. This Letter of Credit is transferable. Transfers and assignments of proceeds are to be effected without charge to either the beneficiary or the transferee/assignee of proceeds. Such transfer or assignment shall be only at the written direction of the Government (the beneficiary) in a form satisfactory to the issuing financial institution and the confirming financial institution, if any.

5. This Letter of Credit is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution, if any, otherwise state of issuing financial institution].

6. If this credit expires during an interruption of business of this financial institution as described in Article 17 of the UCP, the financial institution specifically agrees to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

[Issuing financial institution]

(f) The following format shall be used by the financial institution to confirm an ILC:

_____ [Confirming Financial Institution's Letterhead or Name and Address]

(Date) _____

Our Letter of Credit Advice Number _____

Beneficiary: _____ [U.S. Government agency]

Issuing Financial Institution: _____

Issuing Financial Institution's LC No.: _____

Gentlemen:

1. We hereby confirm the above indicated Letter of Credit, the original of which is attached, issued by _____ [name of issuing financial institution] for drawings of up to United States dollars _____/U.S. \$ _____ and expiring with our close of business on _____ [the expiration date], or any automatically extended expiration date.

2. Draft(s) drawn under the Letter of Credit and this Confirmation are payable at our office located at _____.

3. We hereby undertake to honor sight draft(s) drawn under and presented with the Letter of Credit and this Confirmation at our offices as specified herein.

4. [This paragraph is omitted if used as a bid guarantee, and subsequent paragraphs are renumbered.] It is a condition of this confirmation that it be deemed automatically extended without amendment for one year from the expiration

date hereof, or any automatically extended expiration date, unless:

(a) At least 60 days prior to any such expiration date, we shall notify the Contracting Officer, or the transferee and the issuing financial institution, by registered mail or other receipted means of delivery, that we elect not to consider this confirmation extended for any such additional period; or

(b) The issuing financial institution shall have exercised its right to notify you or the transferee, the account party, and ourselves, of its election not to extend the expiration date of the Letter of Credit.

5. This confirmation is subject to the Uniform Customs and Practice (UCP) for Documentary Credits, 1993 Revision, International Chamber of Commerce Publication No. 500, and to the extent not inconsistent therewith, to the laws of _____ [state of confirming financial institution].

6. If this confirmation expires during an interruption of business of this financial institution as described in Article 17 of the UCP, we specifically agree to effect payment if this credit is drawn against within 30 days after the resumption of our business.

Sincerely,

[Confirming financial institution]

(g) The following format shall be used by the Contracting Officer for a sight draft to draw on the Letter of Credit:

SIGHT DRAFT

[City, State]

(Date) _____

[Name and address of financial institution]

Pay to the order of _____ [Beneficiary Agency] _____ the sum of United States
\$ _____. This draft is drawn under Irrevocable Letter of Credit No.

_____.

[Beneficiary Agency]

By: _____

(End of clause)

52.228-15 PERFORMANCE AND PAYMENT BONDS--CONSTRUCTION (JUL 2000)-

(a) Definitions. As used in this clause--

Original contract price means the award price of the contract; or, for requirements contracts, the price payable for the estimated total quantity; or, for indefinite-quantity contracts, the price payable for the specified minimum quantity. Original contract price does not include the price of any options, except those options exercised at the time of contract award.

(b) Amount of required bonds. Unless the resulting contract price is \$100,000 or less, the successful offeror shall furnish performance and payment bonds to the Contracting Officer as follows:

(1) Performance bonds (Standard Form 25). The penal amount of performance bonds at the time of contract award shall be 100 percent of the original contract price.

(2) Payment Bonds (Standard Form 25-A). The penal amount of payment bonds at the time of contract award shall be 100 percent of the original contract price.

(3) Additional bond protection. (i) The Government may require additional performance and payment bond protection if the contract price is increased. The increase in protection generally will equal 100 percent of the increase in contract price.

(ii) The Government may secure the additional protection by directing the Contractor to increase the penal amount of the existing bond or to obtain an additional bond.

(c) Furnishing executed bonds. The Contractor shall furnish all executed bonds, including any necessary reinsurance agreements, to the Contracting Officer, within the time period specified in the Bid Guarantee provision of the solicitation, or otherwise specified by the Contracting Officer, but in any event, before starting work.

(d) Surety or other security for bonds. The bonds shall be in the form of firm commitment, supported by corporate sureties whose names appear on the list contained in Treasury Department Circular 570, individual sureties, or by other acceptable security such as postal money order, certified check, cashier's check, irrevocable letter of credit, or, in accordance with Treasury Department regulations, certain bonds or notes of the United States. Treasury Circular 570 is published in the Federal Register or may be obtained from the U.S. Department of Treasury, Financial Management Service, Surety Bond Branch, 401 14th Street, NW, 2nd Floor, West Wing, Washington, DC 20227.

(e) Notice of subcontractor waiver of protection (40 U.S.C. 270b(c)). Any waiver of the right to sue on the payment bond is void unless it is in writing, signed by the person whose right is waived, and executed after such person has first furnished labor or material for use in the performance of the contract.

(End of clause)

52.229-3 FEDERAL, STATE, AND LOCAL TAXES (JAN 1991)

(a) "Contract date," as used in this clause, means the date set for bid opening or, if this is a negotiated contract or a modification, the effective date of this contract or modification.

"All applicable Federal, State, and local taxes and duties," as used in this clause, means all taxes and duties, in effect on the contract date, that the taxing authority is imposing and collecting on the transactions or property covered by this contract.

"After-imposed Federal tax," as used in this clause, means any new or increased Federal excise tax or duty, or tax that was exempted or excluded on the contract date but whose exemption was later revoked or reduced during the contract period, on the transactions or property covered by this contract that the Contractor is required to pay or bear as the result of legislative, judicial, or administrative action taking effect after the contract date. It does not

include social security tax or other employment taxes.

"After-relieved Federal tax," as used in this clause, means any amount of Federal excise tax or duty, except social security or other employment taxes, that would otherwise have been payable on the transactions or property covered by this contract, but which the Contractor is not required to pay or bear, or for which the Contractor obtains a refund or drawback, as the result of legislative, judicial, or administrative action taking effect after the contract date.

(b) The contract price includes all applicable Federal, State, and local taxes and duties.

(c) The contract price shall be increased by the amount of any after-imposed Federal tax, provided the Contractor warrants in writing that no amount for such newly imposed Federal excise tax or duty or rate increase was included in the contract price, as a contingency reserve or otherwise.

(d) The contract price shall be decreased by the amount of any after-relieved Federal tax.

(e) The contract price shall be decreased by the amount of any Federal excise tax or duty, except social security or other employment taxes, that the Contractor is required to pay or bear, or does not obtain a refund of, through the Contractor's fault, negligence, or failure to follow instructions of the Contracting Officer.

(f) No adjustment shall be made in the contract price under this clause unless the amount of the adjustment exceeds \$250.

(g) The Contractor shall promptly notify the Contracting Officer of all matters relating to any Federal excise tax or duty that reasonably may be expected to result in either an increase or decrease in the contract price and shall take appropriate action as the Contracting Officer directs.

(h) The Government shall, without liability, furnish evidence appropriate to establish exemption from any Federal, State, or local tax when the Contractor requests such evidence and a reasonable basis exists to sustain the exemption.

(End of clause)

52.230-3 DISCLOSURE AND CONSISTENCY OF COST ACCOUNTING PRACTICES (APR 1998)

(a) The Contractor, in connection with this contract, shall--

(1) Comply with the requirements of 48 CFR 9904.401, Consistency in Estimating, Accumulating, and Reporting Costs; 48 CFR 9904.402, Consistency in Allocating Costs Incurred for the Same Purpose; 48 CFR 9904.405, Accounting for Unallowable Costs; and 48 CFR 9904.406, Cost Accounting Standard--Cost Accounting Period, in effect on the date of award of this contract as indicated in 48 CFR Part 9904.

(2) (CAS-covered Contracts Only) If it is a business unit of a company required to submit a Disclosure Statement, disclose in writing its cost accounting practices as required by 48 CFR 9903.202-1 through 9903.202-5. If the Contractor has notified the Contracting Officer that the Disclosure Statement contains trade secrets and commercial or financial information which is privileged and confidential, the Disclosure Statement shall be protected and shall not be released outside of the Government.

(3)(i) Follow consistently the Contractor's cost accounting practices. A change to such practices may be proposed, however, by either the Government or the Contractor, and the Contractor agrees to negotiate with the Contracting Officer the terms and conditions under which a change may be made. After the terms and conditions under which the change is to be made have been agreed to, the change must be applied prospectively to this contract, and the Disclosure Statement, if affected, must be amended accordingly.

(ii) The Contractor shall, when the parties agree to a change to a cost accounting practice and the Contracting Officer has made the finding required in 48 CFR 9903.201-6(b), that the change is desirable and not detrimental to the interests of the Government, negotiate an equitable adjustment as provided in the Changes clause of this contract. In the absence of the required finding, no agreement may be made under this contract clause that will increase costs paid by the United States.

(4) Agree to an adjustment of the contract price or cost allowance, as appropriate, if the Contractor or a subcontractor fails to comply with the applicable CAS or to follow any cost accounting practice, and such failure results in any increased costs paid by the United States. Such adjustment shall provide for recovery of the increased costs to the United States together with interest thereon computed at the annual rate of interest established under the Internal Revenue Code of 1986 (26 U.S.C. 6621), from the time the payment by the United States was made to the time the adjustment is effected.

(b) If the parties fail to agree whether the Contractor has complied with an applicable CAS, rule, or regulation as specified in 48 CFR 9903 and 9904 and as to any cost adjustment demanded by the United States, such failure to agree will constitute a dispute under the Contract Disputes Act (41 U.S.C. 601).

(c) The Contractor shall permit any authorized representatives of the Government to examine and make copies of any documents, papers, and records relating to compliance with the requirements of this clause.

(d) The Contractor shall include in all negotiated subcontracts, which the Contractor enters into, the substance of this clause, except paragraph (b), and shall require such inclusion in all other subcontracts of any tier, except that--

(1) If the subcontract is awarded to a business unit which pursuant to 48 CFR 9903.201-2 is subject to other types of CAS coverage, the substance of the applicable clause set forth in subsection 30.201-4 of the Federal Acquisition Regulation shall be inserted.

(2) This requirement shall apply only to negotiated subcontracts in excess of \$500,000.

(3) The requirement shall not apply to negotiated subcontracts otherwise exempt from the requirement to include a CAS clause as specified in 48 CFR 9903.201-1.

(End of clause)

52.232-5 PAYMENTS UNDER FIXED-PRICE CONSTRUCTION CONTRACTS (SEP 2002)

(a) Payment of price. The Government shall pay the Contractor the contract price as provided in this contract.

(b) Progress payments. The Government shall make progress payments monthly as the work proceeds, or at more frequent intervals as determined by the Contracting Officer, on estimates of work accomplished which meets the standards of quality established under the contract, as approved by the Contracting Officer.

(1) The Contractor's request for progress payments shall include the following substantiation:

(i) An itemization of the amounts requested, related to the various elements of work required by the contract covered by the payment requested.

(ii) A listing of the amount included for work performed by each subcontractor under the contract.

(iii) A listing of the total amount of each subcontract under the contract.

- (iv) A listing of the amounts previously paid to each such subcontractor under the contract.
- (v) Additional supporting data in a form and detail required by the Contracting Officer.
- (2) In the preparation of estimates, the Contracting Officer may authorize material delivered on the site and preparatory work done to be taken into consideration. Material delivered to the Contractor at locations other than the site also may be taken into consideration if--
 - (i) Consideration is specifically authorized by this contract; and
 - (ii) The Contractor furnishes satisfactory evidence that it has acquired title to such material and that the material will be used to perform this contract.
- (c) Contractor certification. Along with each request for progress payments, the Contractor shall furnish the following certification, or payment shall not be made: (However, if the Contractor elects to delete paragraph (c)(4) from the certification, the certification is still acceptable.)

I hereby certify, to the best of my knowledge and belief, that--

- (1) The amounts requested are only for performance in accordance with the specifications, terms, and conditions of the contract;
- (2) All payments due to subcontractors and suppliers from previous payments received under the contract have been made, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of chapter 39 of Title 31, United States Code;
- (3) This request for progress payments does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract; and
- (4) This certification is not to be construed as final acceptance of a subcontractor's performance.

(Name)

(Title)

(Date)

(d) Refund of unearned amounts. If the Contractor, after making a certified request for progress payments, discovers that a portion or all of such request constitutes a payment for performance by the Contractor that fails to conform to the specifications, terms, and conditions of this contract (hereinafter referred to as the "unearned amount"), the Contractor shall--

- (1) Notify the Contracting Officer of such performance deficiency; and
- (2) Be obligated to pay the Government an amount (computed by the Contracting Officer in the manner provided in paragraph (j) of this clause) equal to interest on the unearned amount from the 8th day after the date of receipt of the unearned amount until--

- (i) The date the Contractor notifies the Contracting Officer that the performance deficiency has been corrected; or
- (ii) The date the Contractor reduces the amount of any subsequent certified request for progress payments by an amount equal to the unearned amount.

(e) Retainage. If the Contracting Officer finds that satisfactory progress was achieved during any period for which a progress payment is to be made, the Contracting Officer shall authorize payment to be made in full. However, if satisfactory progress has not been made, the Contracting Officer may retain a maximum of 10 percent of the amount of the payment until satisfactory progress is achieved. When the work is substantially complete, the Contracting Officer may retain from previously withheld funds and future progress payments that amount the Contracting Officer considers adequate for protection of the Government and shall release to the Contractor all the remaining withheld funds. Also, on completion and acceptance of each separate building, public work, or other division of the contract, for which the price is stated separately in the contract, payment shall be made for the completed work without retention of a percentage.

(f) Title, liability, and reservation of rights. All material and work covered by progress payments made shall, at the time of payment, become the sole property of the Government, but this shall not be construed as--

(1) Relieving the Contractor from the sole responsibility for all material and work upon which payments have been made or the restoration of any damaged work; or

(2) Waiving the right of the Government to require the fulfillment of all of the terms of the contract.

(g) Reimbursement for bond premiums. In making these progress payments, the Government shall, upon request, reimburse the Contractor for the amount of premiums paid for performance and payment bonds (including coinsurance and reinsurance agreements, when applicable) after the Contractor has furnished evidence of full payment to the surety. The retainage provisions in paragraph (e) of this clause shall not apply to that portion of progress payments attributable to bond premiums.

(h) Final payment. The Government shall pay the amount due the Contractor under this contract after--

(1) Completion and acceptance of all work;

(2) Presentation of a properly executed voucher; and

(3) Presentation of release of all claims against the Government arising by virtue of this contract, other than claims, in stated amounts, that the Contractor has specifically excepted from the operation of the release. A release may also be required of the assignee if the Contractor's claim to amounts payable under this contract has been assigned under the Assignment of Claims Act of 1940 (31 U.S.C. 3727 and 41 U.S.C. 15).

(i) Limitation because of undefinitized work. Notwithstanding any provision of this contract, progress payments shall not exceed 80 percent on work accomplished on undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in FAR Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes.

(j) Interest computation on unearned amounts. In accordance with 31 U.S.C. 3903(c)(1), the amount payable under subparagraph (d)(2) of this clause shall be--

(1) Computed at the rate of average bond equivalent rates of 91-day Treasury bills auctioned at the most recent auction of such bills prior to the date the Contractor receives the unearned amount; and

(2) Deducted from the next available payment to the Contractor.

(End of clause)

52.232-16 PROGRESS PAYMENTS (FEB 2002)

The Government will make progress payments to the Contractor when requested as work progresses, but not more frequently than monthly, in amounts of \$2,500 or more approved by the Contracting Officer, under the following conditions:

(a) Computation of amounts. (1) Unless the Contractor requests a smaller amount, the Government will compute each progress payment as 80 percent of the Contractor's total costs incurred under this contract whether or not actually paid, plus financing payments to subcontractors (see paragraph (j) of this clause), less the sum of all previous progress payments made by the Government under this contract. The Contracting Officer will consider cost of money that would be allowable under FAR 31.205-10 as an incurred cost for progress payment purposes.

(2) The amount of financing and other payments for supplies and services purchased directly for the contract are limited to the amounts that have been paid by cash, check, or other forms of payment, or that will be paid to subcontractors--

(i) In accordance with the terms and conditions of a subcontract or invoice; and

(ii) Ordinarily prior to the submission of the Contractor's next payment request to the Government.

(3) The Government will exclude accrued costs of Contractor contributions under employee pension plans until actually paid unless--

(i) The Contractor's practice is to make contributions to the retirement fund quarterly or more frequently; and

(ii) The contribution does not remain unpaid 30 days after the end of the applicable quarter or shorter payment period (any contribution remaining unpaid shall be excluded from the Contractor's total costs for progress payments until paid).

(4) The Contractor shall not include the following in total costs for progress payment purposes in paragraph (a)(1)(i) of this clause:

(i) Costs that are not reasonable, allocable to this contract, and consistent with sound and generally accepted accounting principles and practices.

(ii) Costs incurred by subcontractors or suppliers.

(iii) Costs ordinarily capitalized and subject to depreciation or amortization except for the properly depreciated or amortized portion of such costs.

(iv) Payments made or amounts payable to subcontractors or suppliers, except for --

(A) completed work, including partial deliveries, to which the Contractor has acquired title; and

(B) Work under cost-reimbursement or time-and-material subcontracts to which the Contractor has acquired title.

(5) The amount of unliquidated progress payments may exceed neither (i) the progress payments made against incomplete work (including allowable unliquidated progress payments to subcontractors) nor

(ii) the value, for progress payment purposes, of the incomplete work. Incomplete work shall be considered to be the supplies and services required by this contract, for which delivery and invoicing by the Contractor and acceptance by the Government are incomplete.

(6) The total amount of progress payments shall not exceed 80 percent of the total contract price.

(7) If a progress payment or the unliquidated progress payments exceed the amounts permitted by subparagraphs (a)(4) or (a)(5) above, the Contractor shall repay the amount of such excess to the Government on demand.

(8) Notwithstanding any other terms of the contract, the Contractor agrees not to request progress payments in dollar amounts of less than \$2,500. The Contracting Officer may make exceptions.

(b) Liquidation. Except as provided in the Termination for Convenience of the Government clause, all progress payments shall be liquidated by deducting from any payment under this contract, other than advance or progress payments, the unliquidated progress payments, or 80 percent of the amount invoiced, whichever is less. The Contractor shall repay to the Government any amounts required by a retroactive price reduction, after computing liquidations and payments on past invoices at the reduced prices and adjusting the unliquidated progress payments accordingly. The Government reserves the right to unilaterally change from the ordinary liquidation rate to an alternate rate when deemed appropriate for proper contract financing.

(c) Reduction or suspension. The Contracting Officer may reduce or suspend progress payments, increase the rate of liquidation, or take a combination of these actions, after finding on substantial evidence any of the following conditions:

(1) The Contractor failed to comply with any material requirement of this contract (which includes paragraphs (f) and (g) below).

(2) Performance of this contract is endangered by the Contractor's

(i) failure to make progress or

(ii) unsatisfactory financial condition.

(3) Inventory allocated to this contract substantially exceeds reasonable requirements.

(4) The Contractor is delinquent in payment of the costs of performing this contract in the ordinary course of business.

(5) The unliquidated progress payments exceed the fair value of the work accomplished on the undelivered portion of this contract.

(6) The Contractor is realizing less profit than that reflected in the establishment of any alternate liquidation rate in paragraph (b) above, and that rate is less than the progress payment rate stated in subparagraph (a)(1) above.

(d) Title.

(1) Title to the property described in this paragraph (d) shall vest in the Government. Vestiture shall be immediately upon the date of this contract, for property acquired or produced before that date. Otherwise, vestiture shall occur when the property is or should have been allocable or properly chargeable to this contract.

(2) "Property," as used in this clause, includes all of the below-described items acquired or produced by the Contractor that are or should be allocable or properly chargeable to this contract under sound and generally accepted accounting principles and practices.

(i) Parts, materials, inventories, and work in process;

(ii) Special tooling and special test equipment to which the Government is to acquire title under any other clause of this contract;

(iii) Nondurable (i.e., noncapital) tools, jigs, dies, fixtures, molds, patterns, taps, gauges, test equipment, and other similar manufacturing aids, title to which would not be obtained as special tooling under subparagraph (ii) above; and

(iv) Drawings and technical data, to the extent the Contractor or subcontractors are required to deliver them to the Government by other clauses of this contract.

(3) Although title to property is in the Government under this clause, other applicable clauses of this contract; e.g., the termination or special tooling clauses, shall determine the handling and disposition of the property.

(4) The Contractor may sell any scrap resulting from production under this contract without requesting the Contracting Officer's approval, but the proceeds shall be credited against the costs of performance.

(5) To acquire for its own use or dispose of property to which title is vested in the Government under this clause, the Contractor must obtain the Contracting Officer's advance approval of the action and the terms. The Contractor shall (i) exclude the allocable costs of the property from the costs of contract performance, and (ii) repay to the Government any amount of unliquidated progress payments allocable to the property. Repayment may be by cash or credit memorandum.

(6) When the Contractor completes all of the obligations under this contract, including liquidation of all progress payments, title shall vest in the Contractor for all property (or the proceeds thereof) not--

(i) Delivered to, and accepted by, the Government under this contract; or

(ii) Incorporated in supplies delivered to, and accepted by, the Government under this contract and to which title is vested in the Government under this clause.

(7) The terms of this contract concerning liability for Government-furnished property shall not apply to property to which the Government acquired title solely under this clause.

(e) Risk of loss. Before delivery to and acceptance by the Government, the Contractor shall bear the risk of loss for property, the title to which vests in the Government under this clause, except to the extent the Government expressly assumes the risk. The Contractor shall repay the Government an amount equal to the unliquidated progress payments that are based on costs allocable to property that is damaged, lost, stolen, or destroyed.

(f) Control of costs and property. The Contractor shall maintain an accounting system and controls adequate for the proper administration of this clause.

(g) Reports and access to records. The Contractor shall promptly furnish reports, certificates, financial statements, and other pertinent information reasonably requested by the Contracting Officer for the administration of this clause. Also, the Contractor shall give the Government reasonable opportunity to examine and verify the Contractor's books, records, and accounts.

(h) Special terms regarding default. If this contract is terminated under the Default clause, (i) the Contractor shall, on demand, repay to the Government the amount of unliquidated progress payments and (ii) title shall vest in the

Contractor, on full liquidation of progress payments, for all property for which the Government elects not to require delivery under the Default clause. The Government shall be liable for no payment except as provided by the Default clause.

(i) Reservations of rights. (1) No payment or vesting of title under this clause shall (i) excuse the Contractor from performance of obligations under this contract or (ii) constitute a waiver of any of the rights or remedies of the parties under the contract.

(2) The Government's rights and remedies under this clause

(i) Shall not be exclusive but rather shall be in addition to any other rights and remedies provided by law or this contract and

(ii) Shall not be affected by delayed, partial, or omitted exercise of any right, remedy, power, or privilege, nor shall such exercise or any single exercise preclude or impair any further exercise under this clause or the exercise of any other right, power, or privilege of the Government.

(j) Financing payments to subcontractors. The financing payments to subcontractors mentioned in paragraphs (a)(1) and (a)(2) of this clause shall be all financing payments to subcontractors or divisions, if the following conditions are met:

(1) The amounts included are limited to--

(i) The unliquidated remainder of financing payments made; plus

(ii) Any unpaid subcontractor requests for financing payments.

(2) The subcontract or interdivisional order is expected to involve a minimum of approximately 6 months between the beginning of work and the first delivery; or, if the subcontractor is a small business concern, 4 months.

(3) If the financing payments are in the form of progress payments, the terms of the subcontract or interdivisional order concerning progress payments--

(i) Are substantially similar to the terms of this clause for any subcontractor that is a large business concern, or this clause with its Alternate I for any subcontractor that is a small business concern;

(ii) Are at least as favorable to the Government as the terms of this clause;

(iii) Are not more favorable to the subcontractor or division than the terms of this clause are to the Contractor;

(iv) Are in conformance with the requirements of FAR 32.504(e); and

(v) Subordinate all subcontractor rights concerning property to which the Government has title under the subcontract to the Government's right to require delivery of the property to the Government if--

(A) The Contractor defaults; or

(B) The subcontractor becomes bankrupt or insolvent.

(4) If the financing payments are in the form of performance-based payments, the terms of the subcontract or interdivisional order concerning payments--

(i) Are substantially similar to the Performance-Based Payments clause at FAR 52.232-32 and meet the criteria for, and definition of, performance-based payments in FAR Part 32;

(ii) Are in conformance with the requirements of FAR 32.504(f); and

(iii) Subordinate all subcontractor rights concerning property to which the Government has title under the subcontract to the Government's right to require delivery of the property to the Government if--

(A) The Contractor defaults; or

(B) The subcontractor becomes bankrupt or insolvent.

(5) If the financing payments are in the form of commercial item financing payments, the terms of the subcontract or interdivisional order concerning payments--

(i) Are constructed in accordance with FAR 32.206(c) and included in a subcontract for a commercial item purchase that meets the definition and standards for acquisition of commercial items in FAR Parts 2 and 12;

(ii) Are in conformance with the requirements of FAR 32.504(g); and

(iii) Subordinate all subcontractor rights concerning property to which the Government has title under the subcontract to the Government's right to require delivery of the property to the Government if--

(A) The Contractor defaults; or

(B) The subcontractor becomes bankrupt or insolvent.

(6) If financing is in the form of progress payments, the progress payment rate in the subcontract is the customary rate used by the contracting agency, depending on whether the subcontractor is or is not a small business concern.

(7) Concerning any proceeds received by the Government for property to which title has vested in the Government under the subcontract terms, the parties agree that the proceeds shall be applied to reducing any unliquidated financing payments by the Government to the Contractor under this contract.

(8) If no unliquidated financing payments to the Contractor remain, but there are unliquidated financing payments that the Contractor has made to any subcontractor, the Contractor shall be subrogated to all the rights the Government obtained through the terms required by this clause to be in any subcontract, as if all such rights had been assigned and transferred to the Contractor.

(9) To facilitate small business participation in subcontracting under this contract, the Contractor shall provide financing payments to small business concerns, in conformity with the standards for customary contract financing payments stated in Subpart 32.113. The Contractor shall not consider the need for such financing payments as a handicap or adverse factor in the award of subcontracts.

(k) Limitations on undefinitized contract actions. Notwithstanding any other progress payment provisions in this contract, progress payments may not exceed 80 percent of costs incurred on work accomplished under undefinitized contract actions. A "contract action" is any action resulting in a contract, as defined in Subpart 2.1, including contract modifications for additional supplies or services, but not including contract modifications that are within the scope and under the terms of the contract, such as contract modifications issued pursuant to the Changes clause, or funding and other administrative changes. This limitation shall apply to the costs incurred, as computed in accordance with paragraph (a) of this clause, and shall remain in effect until the contract action is definitized. Costs incurred which are subject to this limitation shall be segregated on Contractor progress payment requests and invoices from those costs eligible for higher progress payment rates. For purposes of progress payment liquidation,

as described in paragraph (b) of this clause, progress payments for undefinitized contract actions shall be liquidated at 80 percent of the amount invoiced for work performed under the undefinitized contract action as long as the contract action remains undefinitized. The amount of unliquidated progress payments for undefinitized contract actions shall not exceed 80 percent of the maximum liability of the Government under the undefinitized contract action or such lower limit specified elsewhere in the contract. Separate limits may be specified for separate actions.

(1) Due date. The designated payment office will make progress payments on the 30 (Contracting Officer insert date as prescribed by agency head; if not prescribed, insert "30th") day after the designated billing office receives a proper progress payment request. In the event that the Government requires an audit or other review of a specific progress payment request to ensure compliance with the terms and conditions of the contract, the designated payment office is not compelled to make payment by the specified due date. Progress payments are considered contract financing and are not subject to the interest penalty provisions of the Prompt Payment Act.

(End of clause)

52.232-17 INTEREST (JUNE 1996)

(a) Except as otherwise provided in this contract under a Price Reduction for Defective Cost or Pricing Data clause or a Cost Accounting Standards clause, all amounts that become payable by the Contractor to the Government under this contract (net of any applicable tax credit under the Internal Revenue Code (26 U.S.C. 1481)) shall bear simple interest from the date due until paid unless paid within 30 days of becoming due. The interest rate shall be the interest rate established by the Secretary of the Treasury as provided in Section 12 of the Contract Disputes Act of 1978 (Public Law 95-563), which is applicable to the period in which the amount becomes due, as provided in paragraph (b) of this clause, and then at the rate applicable for each six-month period as fixed by the Secretary until the amount is paid. reproduce, prepare derivative works, distribute copies to the public, and (b) Amounts shall be due at the earliest of the following dates:

(1) The date fixed under this contract.

(2) The date of the first written demand for payment consistent with this contract, including any demand resulting from a default termination.

(3) The date the Government transmits to the Contractor a proposed supplemental agreement to confirm completed negotiations establishing the amount of debt.

(4) If this contract provides for revision of prices, the date of written notice to the Contractor stating the amount of refund payable in connection with a pricing proposal or a negotiated pricing agreement not confirmed by contract modification.

(c) The interest charge made under this clause may be reduced under the procedures prescribed in 32.614-2 of the Federal Acquisition Regulation in effect on the date of this contract.

(End of clause)

52.232-23 ASSIGNMENT OF CLAIMS (JAN 1986)

(a) The Contractor, under the Assignment of Claims Act, as amended, 31 U.S.C. 3727, 41 U.S.C. 15 (hereafter referred to as "the Act"), may assign its rights to be paid amounts due or to become due as a result of the performance of this

contract to a bank, trust company, or other financing institution, including any Federal lending agency. The assignee under such an assignment may thereafter further assign or reassign its right under the original assignment to any type of financing institution described in the preceding sentence.

(b) Any assignment or reassignment authorized under the Act and this clause shall cover all unpaid amounts payable under this contract, and shall not be made to more than one party, except that an assignment or reassignment may be made to one party as agent or trustee for two or more parties participating in the financing of this contract.

(c) The Contractor shall not furnish or disclose to any assignee under this contract any classified document (including this contract) or information related to work under this contract until the Contracting Officer authorizes such action in writing.

(End of clause)

52.232-27 PROMPT PAYMENT FOR CONSTRUCTION CONTRACTS (FEB 2002)

Notwithstanding any other payment terms in this contract, the Government will make invoice payments under the terms and conditions specified in this clause. The Government considers payment as being made on the day a check is dated or the date of an electronic funds transfer. Definitions of pertinent terms are set forth in sections 2.101, 32.001, and 32.902 of the Federal Acquisition Regulation. All days referred to in this clause are calendar days, unless otherwise specified. (However, see paragraph (a)(3) concerning payments due on Saturdays, Sundays, and legal holidays.)

(a) Invoice payments--(1) Types of invoice payments. For purposes of this clause, there are several types of invoice payments that may occur under this contract, as follows:

(i) Progress payments, if provided for elsewhere in this contract, based on Contracting Officer approval of the estimated amount and value of work or services performed, including payments for reaching milestones in any project.

(A) The due date for making such payments is 14 days after the designated billing office receives a proper payment request. If the designated billing office fails to annotate the payment request with the actual date of receipt at the time of receipt, the payment due date is the 14th day after the date of the Contractor's payment request, provided the designated billing office receives a proper payment request and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(B) The due date for payment of any amounts retained by the Contracting Officer in accordance with the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts, is as specified in the contract or, if not specified, 30 days after approval by the Contracting Officer for release to the Contractor.

(ii) Final payments based on completion and acceptance of all work and presentation of release of all claims against the Government arising by virtue of the contract, and payments for partial deliveries that have been accepted by the Government (e.g., each separate building, public work, or other division of the contract for which the price is stated separately in the contract).

(A) The due date for making such payments is the later of the following two events:

(1) The 30th day after the designated billing office receives a proper invoice from the Contractor.

(2) The 30th day after Government acceptance of the work or services completed by the Contractor. For a final invoice when the payment amount is subject to contract settlement actions (e.g., release of claims), acceptance is deemed to occur on the effective date of the contract settlement.

(B) If the designated billing office fails to annotate the invoice with the date of actual receipt at the time of receipt, the invoice payment due date is the 30th day after the date of the Contractor's invoice, provided the designated billing office receives a proper invoice and there is no disagreement over quantity, quality, or Contractor compliance with contract requirements.

(2) Contractor's invoice. The Contractor shall prepare and submit invoices to the designated billing office specified in the contract. A proper invoice must include the items listed in paragraphs (a)(2)(i) through (a)(2)(xi) of this clause. If the invoice does not comply with these requirements, the designated billing office must return it within 7 days after receipt, with the reasons why it is not a proper invoice. When computing any interest penalty owed the Contractor, the Government will take into account if the Government notifies the Contractor of an improper invoice in an untimely manner.

(i) Name and address of the Contractor.

(ii) Invoice date and invoice number. (The Contractor should date invoices as close as possible to the date of mailing or transmission.)

(iii) Contract number or other authorization for work or services performed (including order number and contract line item number).

(iv) Description of work or services performed.

(v) Delivery and payment terms (e.g., discount for prompt payment terms).

(vi) Name and address of Contractor official to whom payment is to be sent (must be the same as that in the contract or in a proper notice of assignment).

(vii) Name (where practicable), title, phone number, and mailing address of person to notify in the event of a defective invoice.

(viii) For payments described in paragraph (a)(1)(i) of this clause, substantiation of the amounts requested and certification in accordance with the requirements of the clause at 52.232-5, Payments Under Fixed-Price Construction Contracts.

(ix) Taxpayer Identification Number (TIN). The Contractor shall include its TIN on the invoice only if required elsewhere in this contract.

(x) Electronic funds transfer (EFT) banking information.

(A) The Contractor shall include EFT banking information on the invoice only if required elsewhere in this contract.

(B) If EFT banking information is not required to be on the invoice, in order for the invoice to be a proper invoice, the Contractor shall have submitted correct EFT banking information in accordance with the applicable solicitation provision (e.g., 52.232-38, Submission of Electronic Funds Transfer Information with Offer), contract clause (e.g., 52.232-33, Payment by Electronic Funds Transfer--Central Contractor Registration, or 52.232-34, Payment by Electronic Funds Transfer--Other Than Central Contractor Registration), or applicable agency procedures.

(C) EFT banking information is not required if the Government waived the requirement to pay by EFT.

(xi) Any other information or documentation required by the contract.

(3) Interest penalty. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if payment is not made by the due date and the conditions listed in paragraphs (a)(3)(i) through (a)(3)(iii) of this clause are met, if applicable. However, when the due date falls on a Saturday, Sunday, or legal holiday, the designated payment office may make payment on the following working day without incurring a late payment interest penalty.

(i) The designated billing office received a proper invoice.

(ii) The Government processed a receiving report or other Government documentation authorizing payment and there was no disagreement over quantity, quality, Contractor compliance with any contract term or condition, or requested progress payment amount.

(iii) In the case of a final invoice for any balance of funds due the Contractor for work or services performed, the amount was not subject to further contract settlement actions between the Government and the Contractor.

(4) Computing penalty amount. The Government will compute the interest penalty in accordance with the Office of Management and Budget prompt payment regulations at 5 CFR part 1315.

(i) For the sole purpose of computing an interest penalty that might be due the Contractor for payments described in paragraph (a)(1)(ii) of this clause, Government acceptance or approval is deemed to occur constructively on the 7th day after the Contractor has completed the work or services in accordance with the terms and conditions of the contract. If actual acceptance or approval occurs within the constructive acceptance or approval period, the Government will base the determination of an interest penalty on the actual date of acceptance or approval. Constructive acceptance or constructive approval requirements do not apply if there is a disagreement over quantity, quality, or Contractor compliance with a contract provision. These requirements also do not compel Government officials to accept work or services, approve Contractor estimates, perform contract administration functions, or make payment prior to fulfilling their responsibilities.

(ii) The prompt payment regulations at 5 CFR 1315.10(c) do not require the Government to pay interest penalties if payment delays are due to disagreement between the Government and the Contractor over the payment amount or other issues involving contract compliance, or on amounts temporarily withheld or retained in accordance with the terms of the contract. The Government and the Contractor shall resolve claims involving disputes, and any interest that may be payable in accordance with the clause at FAR 52.233-1, Disputes.

(5) Discounts for prompt payment. The designated payment office will pay an interest penalty automatically, without request from the Contractor, if the Government takes a discount for prompt payment improperly. The Government will calculate the interest penalty in accordance with the prompt payment regulations at 5 CFR part 1315.

(6) Additional interest penalty. (i) The designated payment office will pay a penalty amount, calculated in accordance with the prompt payment regulations at 5 CFR part 1315 in addition to the interest penalty amount only if--

(A) The Government owes an interest penalty of \$1 or more;

(B) The designated payment office does not pay the interest penalty within 10 days after the date the invoice amount is paid; and

(C) The Contractor makes a written demand to the designated payment office for additional penalty payment, in accordance with paragraph (a)(6)(ii) of this clause, postmarked not later than 40 days after the date the invoice amount is paid.

(ii)(A) The Contractor shall support written demands for additional penalty payments with the following data. The Government will not request any additional data. The Contractor shall--

(1) Specifically assert that late payment interest is due under a specific invoice, and request payment of all overdue late payment interest penalty and such additional penalty as may be required;

(2) Attach a copy of the invoice on which the unpaid late payment interest was due; and

(3) State that payment of the principal has been received, including the date of receipt.

(B) If there is no postmark or the postmark is illegible--

(1) The designated payment office that receives the demand will annotate it with the date of receipt provided the demand is received on or before the 40th day after payment was made; or

(2) If the designated payment office fails to make the required annotation, the Government will determine the demand's validity based on the date the Contractor has placed on the demand, provided such date is no later than the 40th day after payment was made.

(b) Contract financing payments. If this contract provides for contract financing, the Government will make contract financing payments in accordance with the applicable contract financing clause.

(c) Subcontract clause requirements. The Contractor shall include in each subcontract for property or services (including a material supplier) for the purpose of performing this contract the following:

(1) Prompt payment for subcontractors. A payment clause that obligates the Contractor to pay the subcontractor for satisfactory performance under its subcontract not later than 7 days from receipt of payment out of such amounts as are paid to the Contractor under this contract.

(2) Interest for subcontractors. An interest penalty clause that obligates the Contractor to pay to the subcontractor an interest penalty for each payment not made in accordance with the payment clause--

(i) For the period beginning on the day after the required payment date and ending on the date on which payment of the amount due is made; and

(ii) Computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contract Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(3) Subcontractor clause flowdown. A clause requiring each subcontractor to use:

(i) Include a payment clause and an interest penalty clause conforming to the standards set forth in paragraphs (c)(1) and (c)(2) of this clause in each of its subcontracts; and

(ii) Require each of its subcontractors to include such clauses in their subcontracts with each lower-tier subcontractor or supplier.

(d) Subcontract clause interpretation. The clauses required by paragraph (c) of this clause shall not be construed to impair the right of the Contractor or a subcontractor at any tier to negotiate, and to include in their subcontract, provisions that--

(1) Retainage permitted. Permit the Contractor or a subcontractor to retain (without cause) a specified percentage of each progress payment otherwise due to a subcontractor for satisfactory performance under the subcontract without

incurring any obligation to pay a late payment interest penalty, in accordance with terms and conditions agreed to by the parties to the subcontract, giving such recognition as the parties deem appropriate to the ability of a subcontractor to furnish a performance bond and a payment bond;

(2) Withholding permitted. Permit the Contractor or subcontractor to make a determination that part or all of the subcontractor's request for payment may be withheld in accordance with the subcontract agreement; and

(3) Withholding requirements. Permit such withholding without incurring any obligation to pay a late payment penalty if--

(i) A notice conforming to the standards of paragraph (g) of this clause previously has been furnished to the subcontractor; and

(ii) The Contractor furnishes to the Contracting Officer a copy of any notice issued by a Contractor pursuant to paragraph (d)(3)(i) of this clause.

(e) Subcontractor withholding procedures. If a Contractor, after making a request for payment to the Government but before making a payment to a subcontractor for the subcontractor's performance covered by the payment request, discovers that all or a portion of the payment otherwise due such subcontractor is subject to withholding from the subcontractor in accordance with the subcontract agreement, then the Contractor shall--

(1) Subcontractor notice. Furnish to the subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon ascertaining the cause giving rise to a withholding, but prior to the due date for subcontractor payment;

(2) Contracting Officer notice. Furnish to the Contracting Officer, as soon as practicable, a copy of the notice furnished to the subcontractor pursuant to paragraph (e)(1) of this clause;

(3) Subcontractor progress payment reduction. Reduce the subcontractor's progress payment by an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (e)(1) of this clause;

(4) Subsequent subcontractor payment. Pay the subcontractor as soon as practicable after the correction of the identified subcontract performance deficiency, and--

(i) Make such payment within--

(A) Seven days after correction of the identified subcontract performance deficiency (unless the funds therefor must be recovered from the Government because of a reduction under paragraph (e)(5)(i)) of this clause; or

(B) Seven days after the Contractor recovers such funds from the Government; or

(ii) Incur an obligation to pay a late payment interest penalty computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty;

(5) Notice to Contracting Officer. Notify the Contracting Officer upon--

(i) Reduction of the amount of any subsequent certified application for payment; or

(ii) Payment to the subcontractor of any withheld amounts of a progress payment, specifying--

(A) The amounts withheld under paragraph (e)(1) of this clause; and

(B) The dates that such withholding began and ended; and

(6) Interest to Government. Be obligated to pay to the Government an amount equal to interest on the withheld payments (computed in the manner provided in 31 U.S.C. 3903(c)(1)), from the 8th day after receipt of the withheld amounts from the Government until--

(i) The day the identified subcontractor performance deficiency is corrected; or

(ii) The date that any subsequent payment is reduced under paragraph (e)(5)(i) of this clause.

(f) Third-party deficiency reports--(1) Withholding from subcontractor. If a Contractor, after making payment to a first-tier subcontractor, receives from a supplier or subcontractor of the first-tier subcontractor (hereafter referred to as a "second-tier subcontractor") a written notice in accordance with section 2 of the Act of August 24, 1935 (40 U.S.C. 270b, Miller Act), asserting a deficiency in such first-tier subcontractor's performance under the contract for which the Contractor may be ultimately liable, and the Contractor determines that all or a portion of future payments otherwise due such first-tier subcontractor is subject to withholding in accordance with the subcontract agreement, the Contractor may, without incurring an obligation to pay an interest penalty under paragraph (e)(6) of this clause--

(i) Furnish to the first-tier subcontractor a notice conforming to the standards of paragraph (g) of this clause as soon as practicable upon making such determination; and

(ii) Withhold from the first-tier subcontractor's next available progress payment or payments an amount not to exceed the amount specified in the notice of withholding furnished under paragraph (f)(1)(i) of this clause.

(2) Subsequent payment or interest charge. As soon as practicable, but not later than 7 days after receipt of satisfactory written notification that the identified subcontract performance deficiency has been corrected, the Contractor shall--

(i) Pay the amount withheld under paragraph (f)(1)(ii) of this clause to such first-tier subcontractor; or

(ii) Incur an obligation to pay a late payment interest penalty to such first-tier subcontractor computed at the rate of interest established by the Secretary of the Treasury, and published in the Federal Register, for interest payments under section 12 of the Contracts Disputes Act of 1978 (41 U.S.C. 611) in effect at the time the Contractor accrues the obligation to pay an interest penalty.

(g) Written notice of subcontractor withholding. The Contractor shall issue a written notice of any withholding to a subcontractor (with a copy furnished to the Contracting Officer), specifying--

(1) The amount to be withheld;

(2) The specific causes for the withholding under the terms of the subcontract; and

(3) The remedial actions to be taken by the subcontractor in order to receive payment of the amounts withheld.

(h) Subcontractor payment entitlement. The Contractor may not request payment from the Government of any amount withheld or retained in accordance with paragraph (d) of this clause until such time as the Contractor has determined and certified to the Contracting Officer that the subcontractor is entitled to the payment of such amount.

(i) Prime-subcontractor disputes. A dispute between the Contractor and subcontractor relating to the amount or entitlement of a subcontractor to a payment or a late payment interest penalty under a clause included in the

subcontract pursuant to paragraph (c) of this clause does not constitute a dispute to which the Government is a party. The Government may not be interpleaded in any judicial or administrative proceeding involving such a dispute.

(j) Preservation of prime-subcontractor rights. Except as provided in paragraph (i) of this clause, this clause shall not limit or impair any contractual, administrative, or judicial remedies otherwise available to the Contractor or a subcontractor in the event of a dispute involving late payment or nonpayment by the Contractor or deficient subcontract performance or nonperformance by a subcontractor.

(k) Non-recourse for prime contractor interest penalty. The Contractor's obligation to pay an interest penalty to a subcontractor pursuant to the clauses included in a subcontract under paragraph (c) of this clause shall not be construed to be an obligation of the Government for such interest penalty. A cost-reimbursement claim may not include any amount for reimbursement of such interest penalty.

(l) Overpayments. If the Contractor becomes aware of a duplicate payment or that the Government has otherwise overpaid on an invoice payment, the Contractor shall immediately notify the Contracting Officer and request instructions for disposition of the overpayment.

(End of clause)

52.232-33 PAYMENT BY ELECTRONIC FUNDS TRANSFER—CENTRAL CONTRACTOR REGISTRATION (MAY 1999)

(a) Method of payment. (1) All payments by the Government under this contract shall be made by electronic funds transfer (EFT), except as provided in paragraph (a)(2) of this clause. As used in this clause, the term "EFT" refers to the funds transfer and may also include the payment information transfer.

(2) In the event the Government is unable to release one or more payments by EFT, the Contractor agrees to either--

(i) Accept payment by check or some other mutually agreeable method of payment; or

(ii) Request the Government to extend the payment due date until such time as the Government can make payment by EFT (but see paragraph (d) of this clause).

(b) Contractor's EFT information. The Government shall make payment to the Contractor using the EFT information contained in the Central Contractor Registration (CCR) database. In the event that the EFT information changes, the Contractor shall be responsible for providing the updated information to the CCR database.

(c) Mechanisms for EFT payment. The Government may make payment by EFT through either the Automated Clearing House (ACH) network, subject to the rules of the National Automated Clearing House Association, or the Fedwire Transfer System. The rules governing Federal payments through the ACH are contained in 31 CFR part 210.

(d) Suspension of payment. If the Contractor's EFT information in the CCR database is incorrect, then the Government need not make payment to the Contractor under this contract until correct EFT information is entered into the CCR database; and any invoice or contract financing request shall be deemed not to be a proper invoice for the purpose of prompt payment under this contract. The prompt payment terms of the contract regarding notice of an improper invoice and delays in accrual of interest penalties apply.

(e) Contractor EFT arrangements. If the Contractor has identified multiple payment receiving points (i.e., more than one remittance address and/or EFT information set) in the CCR database, and the Contractor has not notified the

Government of the payment receiving point applicable to this contract, the Government shall make payment to the first payment receiving point (EFT information set or remittance address as applicable) listed in the CCR database.

(f) Liability for uncompleted or erroneous transfers. (1) If an uncompleted or erroneous transfer occurs because the Government used the Contractor's EFT information incorrectly, the Government remains responsible for--

(i) Making a correct payment;

(ii) Paying any prompt payment penalty due; and

(iii) Recovering any erroneously directed funds.

(2) If an uncompleted or erroneous transfer occurs because the Contractor's EFT information was incorrect, or was revised within 30 days of Government release of the EFT payment transaction instruction to the Federal Reserve System, and--

(i) If the funds are no longer under the control of the payment office, the Government is deemed to have made payment and the Contractor is responsible for recovery of any erroneously directed funds; or

(ii) If the funds remain under the control of the payment office, the Government shall not make payment, and the provisions of paragraph (d) of this clause shall apply.

(g) EFT and prompt payment. A payment shall be deemed to have been made in a timely manner in accordance with the prompt payment terms of this contract if, in the EFT payment transaction instruction released to the Federal Reserve System, the date specified for settlement of the payment is on or before the prompt payment due date, provided the specified payment date is a valid date under the rules of the Federal Reserve System.

(h) EFT and assignment of claims. If the Contractor assigns the proceeds of this contract as provided for in the assignment of claims terms of this contract, the Contractor shall require as a condition of any such assignment, that the assignee shall register in the CCR database and shall be paid by EFT in accordance with the terms of this clause. In all respects, the requirements of this clause shall apply to the assignee as if it were the Contractor. EFT information that shows the ultimate recipient of the transfer to be other than the Contractor, in the absence of a proper assignment of claims acceptable to the Government, is incorrect EFT information within the meaning of paragraph (d) of this clause.

(i) Liability for change of EFT information by financial agent. The Government is not liable for errors resulting from changes to EFT information made by the Contractor's financial agent.

(j) Payment information. The payment or disbursing office shall forward to the Contractor available payment information that is suitable for transmission as of the date of release of the EFT instruction to the Federal Reserve System. The Government may request the Contractor to designate a desired format and method(s) for delivery of payment information from a list of formats and methods the payment office is capable of executing. However, the Government does not guarantee that any particular format or method of delivery is available at any particular payment office and retains the latitude to use the format and delivery method most convenient to the Government. If the Government makes payment by check in accordance with paragraph (a) of this clause, the Government shall mail the payment information to the remittance address contained in the CCR database.

(End of Clause)

- (a) This contract is subject to the Contract Disputes Act of 1978, as amended (41 U.S.C. 601-613).
- (b) Except as provided in the Act, all disputes arising under or relating to this contract shall be resolved under this clause.
- (c) Claim, as used in this clause, means a written demand or written assertion by one of the contracting parties seeking, as a matter of right, the payment of money in a sum certain, the adjustment or interpretation of contract terms, or other relief arising under or relating to this contract. However, a written demand or written assertion by the Contractor seeking the payment of money exceeding \$100,000 is not a claim under the Act until certified. A voucher, invoice, or other routine request for payment that is not in dispute when submitted is not a claim under the Act. The submission may be converted to a claim under the Act, by complying with the submission and certification requirements of this clause, if it is disputed either as to liability or amount or is not acted upon in a reasonable time.
- (d)(1) A claim by the Contractor shall be made in writing and, unless otherwise stated in this contract, submitted within 6 years after accrual of the claim to the Contracting Officer for a written decision. A claim by the Government against the Contractor shall be subject to a written decision by the Contracting Officer.
- (2)(i) The contractors shall provide the certification specified in subparagraph (d)(2)(iii) of this clause when submitting any claim -
- (A) Exceeding \$100,000; or
- (B) Regardless of the amount claimed, when using -
- (1) Arbitration conducted pursuant to 5 U.S.C. 575-580; or
- (2) Any other alternative means of dispute resolution (ADR) technique that the agency elects to handle in accordance with the Administrative Dispute Resolution Act (ADRA).
- (ii) The certification requirement does not apply to issues in controversy that have not been submitted as all or part of a claim.
- (iii) The certification shall state as follows: "I certify that the claim is made in good faith; that the supporting data are accurate and complete to the best of my knowledge and belief; that the amount requested accurately reflects the contract adjustment for which the Contractor believes the Government is liable; and that I am duly authorized to certify the claim on behalf of the Contractor.
- (3) The certification may be executed by any person duly authorized to bind the Contractor with respect to the claim.
- (e) For Contractor claims of \$100,000 or less, the Contracting Officer must, if requested in writing by the Contractor, render a decision within 60 days of the request. For Contractor-certified claims over \$100,000, the Contracting Officer must, within 60 days, decide the claim or notify the Contractor of the date by which the decision will be made.
- (f) The Contracting Officer's decision shall be final unless the Contractor appeals or files a suit as provided in the Act.
- (g) If the claim by the Contractor is submitted to the Contracting Officer or a claim by the Government is presented to the Contractor, the parties, by mutual consent, may agree to use alternative dispute resolution (ADR). If the Contractor refuses an offer for ADR, the Contractor shall inform the Contracting Officer, in writing, of the Contractor's specific reasons for rejecting the request.
- (h) The Government shall pay interest on the amount found due and unpaid from (1) the date the Contracting Officer receives the claim (certified, if required); or (2) the date that payment otherwise would be due, if that date is later, until

the date of payment. With regard to claims having defective certifications, as defined in (FAR) 48 CFR 33.201, interest shall be paid from the date that the Contracting Officer initially receives the claim. Simple interest on claims shall be paid at the rate, fixed by the Secretary of the Treasury as provided in the Act, which is applicable to the period during which the Contracting Officer receives the claim and then at the rate applicable for each 6-month period as fixed by the Treasury Secretary during the pendency of the claim.

(i) The Contractor shall proceed diligently with performance of this contract, pending final resolution of any request for relief, claim, appeal, or action arising under the contract, and comply with any decision of the Contracting Officer.

(End of clause)

52.233-3 PROTEST AFTER AWARD (AUG. 1996)

(a) Upon receipt of a notice of protest (as defined in FAR 33.101) or a determination that a protest is likely (see FAR 33.102(d)), the Contracting Officer may, by written order to the Contractor, direct the Contractor to stop performance of the work called for by this contract. The order shall be specifically identified as a stop-work order issued under this clause. Upon receipt of the order, the Contractor shall immediately comply with its terms and take all reasonable steps to minimize the incurrence of costs allocable to the work covered by the order during the period of work stoppage. Upon receipt of the final decision in the protest, the Contracting Officer shall either--

(1) Cancel the stop-work order; or

(2) Terminate the work covered by the order as provided in the Default, or the Termination for Convenience of the Government, clause of this contract.

(b) If a stop-work order issued under this clause is canceled either before or after a final decision in the protest, the Contractor shall resume work. The Contracting Officer shall make an equitable adjustment in the delivery schedule or contract price, or both, and the contract shall be modified, in writing, accordingly, if--

(1) The stop-work order results in an increase in the time required for, or in the Contractor's cost properly allocable to, the performance of any part of this contract; and

(2) The Contractor asserts its right to an adjustment within 30 days after the end of the period of work stoppage; provided, that if the Contracting Officer decides the facts justify the action, the Contracting Officer may receive and act upon a proposal at any time before final payment under this contract.

(c) If a stop-work order is not canceled and the work covered by the order is terminated for the convenience of the Government, the Contracting Officer shall allow reasonable costs resulting from the stop-work order in arriving at the termination settlement.

(d) If a stop-work order is not canceled and the work covered by the order is terminated for default, the Contracting Officer shall allow, by equitable adjustment or otherwise, reasonable costs resulting from the stop-work order.

(e) The Government's rights to terminate this contract at any time are not affected by action taken under this clause.

(f) If, as the result of the Contractor's intentional or negligent misstatement, misrepresentation, or miscertification, a protest related to this contract is sustained, and the Government pays costs, as provided in FAR 33.102(b)(2) or 33.104(h)(1), the Government may require the Contractor to reimburse the Government the amount of such costs. In addition to any other remedy available, and pursuant to the requirements of Subpart 32.6, the Government may collect this debt by offsetting the amount against any payment due the Contractor under any contract between the Contractor and the Government.

(End of clause)

52.236-2 DIFFERING SITE CONDITIONS (APR 1984)

As prescribed in 36.502, insert the following clause in solicitations and contracts when a fixed-price construction contract or a fixed-price dismantling, demolition, or removal of improvements contract is contemplated and the contract amount is expected to exceed the small purchase limitation. The Contracting Officer may insert the clause in solicitations and contracts when a fixed-price construction or a fixed-price contract for dismantling, demolition, or removal of improvements is contemplated and the contract amount is expected to be within the small purchase limitation.

(a) The Contractor shall promptly, and before the conditions are disturbed, give a written notice to the Contracting Officer of

(1) subsurface or latent physical conditions at the site which differ materially from those indicated in this contract, or

(2) unknown physical conditions at the site, of an unusual nature, which differ materially from those ordinarily encountered and generally recognized as inhering in work of the character provided for in the contract.

(b) The Contracting Officer shall investigate the site conditions promptly after receiving the notice. If the conditions do materially so differ and cause an increase or decrease in the Contractor's cost of, or the time required for, performing any part of the work under this contract, whether or not changed as a result of the conditions, an equitable adjustment shall be made under this clause and the contract modified in writing accordingly.

(c) No request by the Contractor for an equitable adjustment to the contract under this clause shall be allowed, unless the Contractor has given the written notice required; provided, that the time prescribed in (a) above for giving written notice may be extended by the Contracting Officer.

(d) No request by the Contractor for an equitable adjustment to the contract for differing site conditions shall be allowed if made after final payment under this contract.

(End of clause)

52.236-3 SITE INVESTIGATION AND CONDITIONS AFFECTING THE WORK (APR 1984)

(a) The Contractor acknowledges that it has taken steps reasonably necessary to ascertain the nature and location of the work, and that it has investigated and satisfied itself as to the general and local conditions which can affect the work or its cost, including but not limited to

(1) conditions bearing upon transportation, disposal, handling, and storage of materials;

(2) the availability of labor, water, electric power, and roads;

(3) uncertainties of weather, river stages, tides, or similar physical conditions at the site;

(4) the conformation and conditions of the ground; and (5) the character of equipment and facilities needed preliminary to and during work performance. The Contractor also acknowledges that it has satisfied itself as to the character, quality, and quantity of surface and subsurface materials or obstacles to be encountered insofar as this

information is reasonably ascertainable from an inspection of the site, including all exploratory work done by the Government, as well as from the drawings and specifications made a part of this contract. Any failure of the Contractor to take the actions described and acknowledged in this paragraph will not relieve the Contractor from responsibility for estimating properly the difficulty and cost of successfully performing the work, or for proceeding to successfully perform the work without additional expense to the Government.

(b) The Government assumes no responsibility for any conclusions or interpretations made by the Contractor based on the information made available by the Government. Nor does the Government assume responsibility for any understanding reached or representation made concerning conditions which can affect the work by any of its officers or agents before the execution of this contract, unless that understanding or representation is expressly stated in this contract.

(End of clause)

52.236-5 MATERIAL AND WORKMANSHIP (APR 1984)

(a) All equipment, material, and articles incorporated into the work covered by this contract shall be new and of the most suitable grade for the purpose intended, unless otherwise specifically provided in this contract. References in the specifications to equipment, material, articles, or patented processes by trade name, make, or catalog number, shall be regarded as establishing a standard of quality and shall not be construed as limiting competition. The Contractor may, at its option, use any equipment, material, article, or process that, in the judgment of the Contracting Officer, is equal to that named in the specifications, unless otherwise specifically provided in this contract.

(b) The Contractor shall obtain the Contracting Officer's approval of the machinery and mechanical and other equipment to be incorporated into the work. When requesting approval, the Contractor shall furnish to the Contracting Officer the name of the manufacturer, the model number, and other information concerning the performance, capacity, nature, and rating of the machinery and mechanical and other equipment. When required by this contract or by the Contracting Officer, the Contractor shall also obtain the Contracting Officer's approval of the material or articles which the Contractor contemplates incorporating into the work. When requesting approval, the Contractor shall provide full information concerning the material or articles. When directed to do so, the Contractor shall submit samples for approval at the Contractor's expense, with all shipping charges prepaid. Machinery, equipment, material, and articles that do not have the required approval shall be installed or used at the risk of subsequent rejection.

(c) All work under this contract shall be performed in a skillful and workmanlike manner. The Contracting Officer may require, in writing, that the Contractor remove from the work any employee the Contracting Officer deems incompetent, careless, or otherwise objectionable.

(End of clause)

52.236-7 PERMITS AND RESPONSIBILITIES (NOV 1991)

The Contractor shall, without additional expense to the Government, be responsible for obtaining any necessary licenses and permits, and for complying with any Federal, State, and municipal laws, codes, and regulations applicable to the performance of the work. The Contractor shall also be responsible for all damages to persons or property that occur as a result of the Contractor's fault or negligence. The Contractor shall also be responsible for all materials delivered and work performed until completion and acceptance of the entire work, except for any completed unit of work which may have been accepted under the contract.

(End of clause)

52.236-8 OTHER CONTRACTS (APR 1984)

The Government may undertake or award other contracts for additional work at or near the site of the work under this contract. The Contractor shall fully cooperate with the other contractors and with Government employees and shall carefully adapt scheduling and performing the work under this contract to accommodate the additional work, heeding any direction that may be provided by the Contracting Officer. The Contractor shall not commit or permit any act that will interfere with the performance of work by any other contractor or by Government employees.

(End of clause)

52.236-9 PROTECTION OF EXISTING VEGETATION, STRUCTURES, EQUIPMENT, UTILITIES, AND IMPROVEMENTS (APR 1984)

(a) The Contractor shall preserve and protect all structures, equipment, and vegetation (such as trees, shrubs, and grass) on or adjacent to the work site, which are not to be removed and which do not unreasonably interfere with the work required under this contract. The Contractor shall only remove trees when specifically authorized to do so, and shall avoid damaging vegetation that will remain in place. If any limbs or branches of trees are broken during contract performance, or by the careless operation of equipment, or by workmen, the Contractor shall trim those limbs or branches with a clean cut and paint the cut with a tree-pruning compound as directed by the Contracting Officer.

(b) The Contractor shall protect from damage all existing improvements and utilities

(1) at or near the work site, and

(2) on adjacent property of a third party, the locations of which are made known to or should be known by the Contractor. The Contractor shall repair any damage to those facilities, including those that are the property of a third party, resulting from failure to comply with the requirements of this contract or failure to exercise reasonable care in performing the work. If the Contractor fails or refuses to repair the damage promptly, the Contracting Officer may have the necessary work performed and charge the cost to the Contractor.

(End of clause)

52.236-10 OPERATIONS AND STORAGE AREAS (APR 1984)

(a) The Contractor shall confine all operations (including storage of materials) on Government premises to areas authorized or approved by the Contracting Officer. The Contractor shall hold and save the Government, its officers and agents, free and harmless from liability of any nature occasioned by the Contractor's performance.

(b) Temporary buildings (e.g., storage sheds, shops, offices) and utilities may be erected by the Contractor only with the approval of the Contracting Officer and shall be built with labor and materials furnished by the Contractor without expense to the Government. The temporary buildings and utilities shall remain the property of the Contractor and shall be removed by the Contractor at its expense upon completion of the work. With the written consent of the Contracting Officer, the buildings and utilities may be abandoned and need not be removed.

(c) The Contractor shall, under regulations prescribed by the Contracting Officer, use only established roadways, or

use temporary roadways constructed by the Contractor when and as authorized by the Contracting Officer. When materials are transported in prosecuting the work, vehicles shall not be loaded beyond the loading capacity recommended by the manufacturer of the vehicle or prescribed by any Federal, State, or local law or regulation. When it is necessary to cross curbs or sidewalks, the Contractor shall protect them from damage. The Contractor shall repair or pay for the repair of any damaged curbs, sidewalks, or roads.

(End of clause)

52.236-11 USE AND POSSESSION PRIOR TO COMPLETION (APR 1984)

(a) The Government shall have the right to take possession of or use any completed or partially completed part of the work. Before taking possession of or using any work, the Contracting Officer shall furnish the Contractor a list of items of work remaining to be performed or corrected on those portions of the work that the Government intends to take possession of or use. However, failure of the Contracting Officer to list any item of work shall not relieve the Contractor of responsibility for complying with the terms of the contract. The Government's possession or use shall not be deemed an acceptance of any work under the contract.

(b) While the Government has such possession or use, the Contractor shall be relieved of the responsibility for the loss of or damage to the work resulting from the Government's possession or use, notwithstanding the terms of the clause in this contract entitled "Permits and Responsibilities." If prior possession or use by the Government delays the progress of the work or causes additional expense to the Contractor, an equitable adjustment shall be made in the contract price or the time of completion, and the contract shall be modified in writing accordingly.

(End of clause)

52.236-12 CLEANING UP (APR 1984)

The Contractor shall at all times keep the work area, including storage areas, free from accumulations of waste materials. Before completing the work, the Contractor shall remove from the work and premises any rubbish, tools, scaffolding, equipment, and materials that are not the property of the Government. Upon completing the work, the Contractor shall leave the work area in a clean, neat, and orderly condition satisfactory to the Contracting Officer.

(End of clause)

52.236-13 ACCIDENT PREVENTION (NOV 1991)

(a) The Contractor shall provide and maintain work environments and procedures which will

(1) safeguard the public and Government personnel, property, materials, supplies, and equipment exposed to Contractor operations and activities;

(2) avoid interruptions of Government operations and delays in project completion dates; and

(3) control costs in the performance of this contract.

(b) For these purposes on contracts for construction or dismantling, demolition, or removal of improvements, the Contractor shall-

- (1) Provide appropriate safety barricades, signs, and signal lights;
- (2) Comply with the standards issued by the Secretary of Labor at 29 CFR Part 1926 and 29 CFR Part 1910; and
- (3) Ensure that any additional measures the Contracting Officer determines to be reasonably necessary for the purposes are taken.
- (c) If this contract is for construction or dismantling, demolition or removal of improvements with any Department of Defense agency or component, the Contractor shall comply with all pertinent provisions of the latest version of U.S. Army Corps of Engineers Safety and Health Requirements Manual, EM 385-1-1, in effect on the date of the solicitation.
- (d) Whenever the Contracting Officer becomes aware of any noncompliance with these requirements or any condition which poses a serious or imminent danger to the health or safety of the public or Government personnel, the Contracting Officer shall notify the Contractor orally, with written confirmation, and request immediate initiation of corrective action. This notice, when delivered to the Contractor or the Contractor's representative at the work site, shall be deemed sufficient notice of the noncompliance and that corrective action is required. After receiving the notice, the Contractor shall immediately take corrective action. If the Contractor fails or refuses to promptly take corrective action, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. The Contractor shall not be entitled to any equitable adjustment of the contract price or extension of the performance schedule on any stop work order issued under this clause.
- (5) The Contractor shall insert this clause, including this paragraph (e), with appropriate changes in the designation of the parties, in subcontracts.

(End of clause)

52.236-14 AVAILABILITY AND USE OF UTILITY SERVICES (APR 1984)

- (a) The Government shall make all reasonably required amounts of utilities available to the Contractor from existing outlets and supplies, as specified in the contract. Unless otherwise provided in the contract, the amount of each utility service consumed shall be charged to or paid for by the Contractor at prevailing rates charged to the Government or, where the utility is produced by the Government, at reasonable rates determined by the Contracting Officer. The Contractor shall carefully conserve any utilities furnished without charge.
- (b) The Contractor, at its expense and in a workmanlike manner satisfactory to the Contracting Officer, shall install and maintain all necessary temporary connections and distribution lines, and all meters required to measure the amount of each utility used for the purpose of determining charges. Before final acceptance of the work by the Government, the Contractor shall remove all the temporary connections, distribution lines, meters, and associated paraphernalia.

(End of clause)

52.236-15 SCHEDULES FOR CONSTRUCTION CONTRACTS (APR 1984)

- (a) The Contractor shall, within five days after the work commences on the contract or another period of time determined by the Contracting Officer, prepare and submit to the Contracting Officer for approval three copies of a practicable schedule showing the order in which the Contractor proposes to perform the work, and the dates on

which the Contractor contemplates starting and completing the several salient features of the work (including acquiring materials, plant, and equipment). The schedule shall be in the form of a progress chart of suitable scale to indicate appropriately the percentage of work scheduled for completion by any given date during the period. If the Contractor fails to submit a schedule within the time prescribed, the Contracting Officer may withhold approval of progress payments until the Contractor submits the required schedule.

(b) The Contractor shall enter the actual progress on the chart as directed by the Contracting Officer, and upon doing so shall immediately deliver three copies of the annotated schedule to the Contracting Officer. If, in the opinion of the Contracting Officer, the Contractor falls behind the approved schedule, the Contractor shall take steps necessary to improve its progress, including those that may be required by the Contracting Officer, without additional cost to the Government. In this circumstance, the Contracting Officer may require the Contractor to increase the number of shifts, overtime operations, days of work, and/or the amount of construction plant, and to submit for approval any supplementary schedule or schedules in chart form as the Contracting Officer deems necessary to demonstrate how the approved rate of progress will be regained.

(c) Failure of the Contractor to comply with the requirements of the Contracting Officer under this clause shall be grounds for a determination by the Contracting Officer that the Contractor is not prosecuting the work with sufficient diligence to ensure completion within the time specified in the contract. Upon making this determination, the Contracting Officer may terminate the Contractor's right to proceed with the work, or any separable part of it, in accordance with the default terms of this contract.

(End of clause)

52.236-21 SPECIFICATIONS AND DRAWINGS FOR CONSTRUCTION (FEB 1997)

(a) The Contractor shall keep on the work site a copy of the drawings and specifications and shall at all times give the Contracting Officer access thereto. Anything mentioned in the specifications and not shown on the drawings, or shown on the drawings and not mentioned in the specifications, shall be of like effect as if shown or mentioned in both. In case of difference between drawings and specifications, the specifications shall govern. In case of discrepancy in the figures, in the drawings, or in the specifications, the matter shall be promptly submitted to the Contracting Officer, who shall promptly make a determination in writing. Any adjustment by the Contractor without such a determination shall be at its own risk and expense. The Contracting Officer shall furnish from time to time such detailed drawings and other information as considered necessary, unless otherwise provided.

(b) Wherever in the specifications or upon the drawings the words "directed", "required", "ordered", "designated", "prescribed", or words of like import are used, it shall be understood that the "direction", "requirement", "order", "designation", or "prescription", of the Contracting Officer is intended and similarly the words "approved", "acceptable", "satisfactory", or words of like import shall mean "approved by," or "acceptable to", or "satisfactory to" the Contracting Officer, unless otherwise expressly stated.

(c) Where "as shown," "as indicated", "as detailed", or words of similar import are used, it shall be understood that the reference is made to the drawings accompanying this contract unless stated otherwise. The word "provided" as used herein shall be understood to mean "provide complete in place," that is "furnished and installed".

(d) Shop drawings means drawings, submitted to the Government by the Contractor, subcontractor, or any lower tier subcontractor pursuant to a construction contract, showing in detail (1) the proposed fabrication and assembly of structural elements, and (2) the installation (i.e., fit, and attachment details) of materials or equipment. It includes drawings, diagrams, layouts, schematics, descriptive literature, illustrations, schedules, performance and test data, and similar materials furnished by the contractor to explain in detail specific portions of the work required by the contract. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.

(e) If this contract requires shop drawings, the Contractor shall coordinate all such drawings, and review them for accuracy, completeness, and compliance with contract requirements and shall indicate its approval thereon as evidence of such coordination and review. Shop drawings submitted to the Contracting Officer without evidence of the Contractor's approval may be returned for resubmission. The Contracting Officer will indicate an approval or disapproval of the shop drawings and if not approved as submitted shall indicate the Government's reasons therefor. Any work done before such approval shall be at the Contractor's risk. Approval by the Contracting Officer shall not relieve the Contractor from responsibility for any errors or omissions in such drawings, nor from responsibility for complying with the requirements of this contract, except with respect to variations described and approved in accordance with (f) below.

(f) If shop drawings show variations from the contract requirements, the Contractor shall describe such variations in writing, separate from the drawings, at the time of submission. If the Contracting Officer approves any such variation, the Contracting Officer shall issue an appropriate contract modification, except that, if the variation is minor or does not involve a change in price or in time of performance, a modification need not be issued.

(g) The Contractor shall submit to the Contracting Officer for approval four copies (unless otherwise indicated) of all shop drawings as called for under the various headings of these specifications. Three sets (unless otherwise indicated) of all shop drawings, will be retained by the Contracting Officer and one set will be returned to the Contractor.

(End of clause)

52.236-26 PRECONSTRUCTION CONFERENCE (FEB 1995)

If the Contracting Officer decides to conduct a preconstruction conference, the successful offeror will be notified and will be required to attend. The Contracting Officer's notification will include specific details regarding the date, time, and location of the conference, any need for attendance by subcontractors, and information regarding the items to be discussed.

(End of clause)

52.242-13 BANKRUPTCY (JUL 1995)

In the event the Contractor enters into proceedings relating to bankruptcy, whether voluntary or involuntary, the Contractor agrees to furnish, by certified mail or electronic commerce method authorized by the contract, written notification of the bankruptcy to the Contracting Officer responsible for administering the contract. This notification shall be furnished within five days of the initiation of the proceedings relating to bankruptcy filing. This notification shall include the date on which the bankruptcy petition was filed, the identity of the court in which the bankruptcy petition was filed, and a listing of Government contract numbers and contracting offices for all Government contracts against which final payment has not been made. This obligation remains in effect until final payment under this contract.

(End of clause)

52.242-14 SUSPENSION OF WORK (APR 1984)

(a) The Contracting Officer may order the Contractor, in writing, to suspend, delay, or interrupt all or any part of the

work of this contract for the period of time that the Contracting Officer determines appropriate for the convenience of the Government.

(b) If the performance of all or any part of the work is, for an unreasonable period of time, suspended, delayed, or interrupted (1) by an act of the Contracting Officer in the administration of this contract, or (2) by the Contracting Officer's failure to act within the time specified in this contract (or within a reasonable time if not specified), an adjustment shall be made for any increase in the cost of performance of this contract (excluding profit) necessarily caused by the unreasonable suspension, delay, or interruption, and the contract modified in writing accordingly. However, no adjustment shall be made under this clause for any suspension, delay, or interruption to the extent that performance would have been so suspended, delayed, or interrupted by any other cause, including the fault or negligence of the Contractor, or for which an equitable adjustment is provided for or excluded under any other term or condition of this contract. (c) A claim under this clause shall not be allowed (1) for any costs incurred more than 20 days before the Contractor shall have notified the Contracting Officer in writing of the act or failure to act involved (but this requirement shall not apply as to a claim resulting from a suspension order), and (2) unless the claim, in an amount stated, is asserted in writing as soon as practicable after the termination of the suspension, delay, or interruption, but not later than the date of final payment under the contract.

(End of clause)

52.243-4 CHANGES (AUG 1987)

(a) The Contracting Officer may, at any time, without notice to the sureties, if any, by written order designated or indicated to be a change order, make changes in the work within the general scope of the contract, including changes--

- (1) In the specifications (including drawings and designs);
- (2) In the method or manner of performance of the work;
- (3) In the Government-furnished facilities, equipment, materials, services, or site; or
- (4) Directing acceleration in the performance of the work.

(b) Any other written or oral order (which, as used in this paragraph (b), includes direction, instruction, interpretation, or determination) from the Contracting Officer that causes a change shall be treated as a change order under this clause; provided, that the Contractor gives the Contracting Officer written notice stating

- (1) the date, circumstances, and source of the order and
- (2) that the Contractor regards the order as a change order.

(c) Except as provided in this clause, no order, statement, or conduct of the Contracting Officer shall be treated as a change under this clause or entitle the Contractor to an equitable adjustment.

(d) If any change under this clause causes an increase or decrease in the Contractor's cost of, or the time required for, the performance of any part of the work under this contract, whether or not changed by any such order, the Contracting Officer shall make an equitable adjustment and modify the contract in writing. However, except for an adjustment based on defective specifications, no adjustment for any change under paragraph (b) of this clause shall be made for any costs incurred more than 20 days before the Contractor gives written notice as required. In the case of defective specifications for which the Government is responsible, the equitable adjustment shall include any increased cost reasonably incurred by the Contractor in attempting to comply with the defective specifications.

(e) The Contractor must assert its right to an adjustment under this clause within 30 days after

(1) receipt of a written change order under paragraph (a) of this clause or (2) the furnishing of a written notice under paragraph (b) of this clause, by submitting to the Contracting Officer a written statement describing the general nature and amount of the proposal, unless this period is extended by the Government. The statement of proposal for adjustment may be included in the notice under paragraph (b) above.

(f) No proposal by the Contractor for an equitable adjustment shall be allowed if asserted after final payment under this contract.

(End of clause)

52.244-6 SUBCONTRACTS FOR COMMERCIAL ITEMS (MAY 2002)

(a) Definitions.

"Commercial item", has the meaning contained in the clause at 52.202-1, Definitions.

"Subcontract", includes a transfer of commercial items between divisions, subsidiaries, or affiliates of the Contractor or subcontractor at any tier.

(b) To the maximum extent practicable, the Contractor shall incorporate, and require its subcontractors at all tiers to incorporate, commercial items or nondevelopmental items as components of items to be supplied under this contract.

(c) (1) The Contractor shall insert the following clauses in subcontracts for commercial items:

(i) 52.219-8, Utilization of Small Business Concerns (OCT 2000) (15 U.S.C. 637(d)(2) and (3)), in all subcontracts that offer further subcontracting opportunities. If the subcontract (except subcontracts to small business concerns) exceeds \$500,000 (\$1,000,000 for construction of any public facility), the subcontractor must include 52.219-8 in lower tier subcontracts that offer subcontracting opportunities.

(ii) 52.222-26, Equal Opportunity (Apr 2002) (E.O. 11246).

(iii) 52.222-35, Equal Opportunity for Special Disabled Veterans, Veterans of the Vietnam Era and Other Eligible Veterans (DEC 2001) (38 U.S.C. 4212(a)).

(iv) 52.222-36, Affirmative Action for Workers with Disabilities (JUN 1998) (29 U.S.C. 793).

(v) 52.247-64, Preference for Privately Owned U.S.-Flag Commercial Vessels (JUN 2000) (46 U.S.C. Appx 1241) (flowdown not required for subcontracts awarded beginning May 1, 1996).

(2) While not required, the Contractor may flow down to subcontracts for commercial items a minimal number of additional clauses necessary to satisfy its contractual obligations.

(d) The Contractor shall include the terms of this clause, including this paragraph (d), in subcontracts awarded under this contract.

(End of clause)

52.246-12 INSPECTION OF CONSTRUCTION (AUG 1996)

(a) Definition. "Work" includes, but is not limited to, materials, workmanship, and manufacture and fabrication of components.

(b) The Contractor shall maintain an adequate inspection system and perform such inspections as will ensure that the work performed under the contract conforms to contract requirements. The Contractor shall maintain complete inspection records and make them available to the Government. All work shall be conducted under the general direction of the Contracting Officer and is subject to Government inspection and test at all places and at all reasonable times before acceptance to ensure strict compliance with the terms of the contract.

(c) Government inspections and tests are for the sole benefit of the Government and do not--

(1) Relieve the Contractor of responsibility for providing adequate quality control measures;

(2) Relieve the Contractor of responsibility for damage to or loss of the material before acceptance;

(3) Constitute or imply acceptance; or

(4) Affect the continuing rights of the Government after acceptance of the completed work under paragraph (i) of this section.

(d) The presence or absence of a Government inspector does not relieve the Contractor from any contract requirement, nor is the inspector authorized to change any term or condition of the specification without the Contracting Officer's written authorization.

(e) The Contractor shall promptly furnish, at no increase in contract price, all facilities, labor, and material reasonably needed for performing such safe and convenient inspections and tests as may be required by the Contracting Officer. The Government may charge to the Contractor any additional cost of inspection or test when work is not ready at the time specified by the Contractor for inspection or test, or when prior rejection makes reinspection or retest necessary. The Government shall perform all inspections and tests in a manner that will not unnecessarily delay the work. Special, full size, and performance tests shall be performed as described in the contract.

(f) The Contractor shall, without charge, replace or correct work found by the Government not to conform to contract requirements, unless in the public interest the Government consents to accept the work with an appropriate adjustment in contract price. The Contractor shall promptly segregate and remove rejected material from the premises.

(g) If the Contractor does not promptly replace or correct rejected work, the Government may (1) by contract or otherwise, replace or correct the work and charge the cost to the Contractor or (2) terminate for default the Contractor's right to proceed.

(h) If, before acceptance of the entire work, the Government decides to examine already completed work by removing it or tearing it out, the Contractor, on request, shall promptly furnish all necessary facilities, labor, and material. If the work is found to be defective or nonconforming in any material respect due to the fault of the Contractor or its subcontractors, the Contractor shall defray the expenses of the examination and of satisfactory reconstruction. However, if the work is found to meet contract requirements, the Contracting Officer shall make an equitable adjustment for the additional services involved in the examination and reconstruction, including, if completion of the work was thereby delayed, an extension of time.

(i) Unless otherwise specified in the contract, the Government shall accept, as promptly as practicable after completion and inspection, all work required by the contract or that portion of the work the Contracting Officer determines can be accepted separately. Acceptance shall be final and conclusive except for latent defects, fraud,

gross mistakes amounting to fraud, or the Government's rights under any warranty or guarantee.

(End of clause)

52.246-21 WARRANTY OF CONSTRUCTION (MAR 1994)

(a) In addition to any other warranties in this contract, the Contractor warrants, except as provided in paragraph (i) of this clause, that work performed under this contract conforms to the contract requirements and is free of any defect in equipment, material, or design furnished, or workmanship performed by the Contractor or any subcontractor or supplier at any tier.

(b) This warranty shall continue for a period of 1 year from the date of final acceptance of the work. If the Government takes possession of any part of the work before final acceptance, this warranty shall continue for a period of 1 year from the date the Government takes possession.

(c) The Contractor shall remedy at the Contractor's expense any failure to conform, or any defect. In addition, the Contractor shall remedy at the Contractor's expense any damage to Government-owned or controlled real or personal property, when that damage is the result of--

(1) The Contractor's failure to conform to contract requirements; or

(2) Any defect of equipment, material, workmanship, or design furnished.

(d) The Contractor shall restore any work damaged in fulfilling the terms and conditions of this clause. The Contractor's warranty with respect to work repaired or replaced will run for 1 year from the date of repair or replacement.

(e) The Contracting Officer shall notify the Contractor, in writing, within a reasonable time after the discovery of any failure, defect, or damage.

(f) If the Contractor fails to remedy any failure, defect, or damage within a reasonable time after receipt of notice, the Government shall have the right to replace, repair, or otherwise remedy the failure, defect, or damage at the Contractor's expense.

(g) With respect to all warranties, express or implied, from subcontractors, manufacturers, or suppliers for work performed and materials furnished under this contract, the Contractor shall--

(1) Obtain all warranties that would be given in normal commercial practice;

(2) Require all warranties to be executed, in writing, for the benefit of the Government, if directed by the Contracting Officer; and

(3) Enforce all warranties for the benefit of the Government, if directed by the Contracting Officer.

(h) In the event the Contractor's warranty under paragraph (b) of this clause has expired, the Government may bring suit at its expense to enforce a subcontractor's, manufacturer's, or supplier's warranty.

(i) Unless a defect is caused by the negligence of the Contractor or subcontractor or supplier at any tier, the Contractor shall not be liable for the repair of any defects of material or design furnished by the Government nor for the repair of any damage that results from any defect in Government-furnished material or design.

(j) This warranty shall not limit the Government's rights under the Inspection and Acceptance clause of this contract with respect to latent defects, gross mistakes, or fraud.

(End of clause)

52.248-3 VALUE ENGINEERING--CONSTRUCTION (FEB 2000)

(a) General. The Contractor is encouraged to develop, prepare, and submit value engineering change proposals (VECP's) voluntarily. The Contractor shall share in any instant contract savings realized from accepted VECP's, in accordance with paragraph (f) below.

(b) Definitions. "Collateral costs," as used in this clause, means agency costs of operation, maintenance, logistic support, or Government-furnished property.

"Collateral savings," as used in this clause, means those measurable net reductions resulting from a VECP in the agency's overall projected collateral costs, exclusive of acquisition savings, whether or not the acquisition cost changes.

"Contractor's development and implementation costs," as used in this clause, means those costs the Contractor incurs on a VECP specifically in developing, testing, preparing, and submitting the VECP, as well as those costs the Contractor incurs to make the contractual changes required by Government acceptance of a VECP.

"Government costs," as used in this clause, means those agency costs that result directly from developing and implementing the VECP, such as any net increases in the cost of testing, operations, maintenance, and logistic support. The term does not include the normal administrative costs of processing the VECP.

"Instant contract savings," as used in this clause, means the estimated reduction in Contractor cost of performance resulting from acceptance of the VECP, minus allowable Contractor's development and implementation costs, including subcontractors' development and implementation costs (see paragraph (h) below).

"Value engineering change proposal (VECP)" means a proposal that--

- (1) Requires a change to this, the instant contract, to implement; and
- (2) Results in reducing the contract price or estimated cost without impairing essential functions or characteristics; provided, that it does not involve a change--
 - (i) In deliverable end item quantities only; or
 - (ii) To the contract type only.

(c) VECP preparation. As a minimum, the Contractor shall include in each VECP the information described in subparagraphs (1) through (7) below. If the proposed change is affected by contractually required configuration management or similar procedures, the instructions in those procedures relating to format, identification, and priority assignment shall govern VECP preparation. The VECP shall include the following:

- (1) A description of the difference between the existing contract requirement and that proposed, the comparative advantages and disadvantages of each, a justification when an item's function or characteristics are being altered, and the effect of the change on the end item's performance.

(2) A list and analysis of the contract requirements that must be changed if the VECP is accepted, including any suggested specification revisions.

(3) A separate, detailed cost estimate for

(i) the affected portions of the existing contract requirement and

(ii) the VECP. The cost reduction associated with the VECP shall take into account the Contractor's allowable development and implementation costs, including any amount attributable to subcontracts under paragraph (h) below.

(4) A description and estimate of costs the Government may incur in implementing the VECP, such as test and evaluation and operating and support costs.

(5) A prediction of any effects the proposed change would have on collateral costs to the agency.

(6) A statement of the time by which a contract modification accepting the VECP must be issued in order to achieve the maximum cost reduction, noting any effect on the contract completion time or delivery schedule.

(7) Identification of any previous submissions of the VECP, including the dates submitted, the agencies and contract numbers involved, and previous Government actions, if known.

(d) Submission. The Contractor shall submit VECP's to the Resident Engineer at the worksite, with a copy to the Contracting Officer.

(e) Government action.

(1) The Contracting Officer will notify the Contractor of the status of the VECP within 45 calendar days after the contracting office receives it. If additional time is required, the Contracting Officer will notify the Contractor within the 45-day period and provide the reason for the delay and the expected date of the decision. The Government will process VECP's expeditiously; however, it shall not be liable for any delay in acting upon a VECP.

If the VECP is not accepted, the Contracting Officer will notify the Contractor in writing, explaining the reasons for rejection. The Contractor may withdraw any VECP, in whole or in part, at any time before it is accepted by the Government. The Contracting Officer may require that the Contractor provide written notification before undertaking significant expenditures for VECP effort.

Any VECP may be accepted, in whole or in part, by the Contracting Officer's award of a modification to this contract citing this clause. The Contracting Officer may accept the VECP, even though an agreement on price reduction has not been reached, by issuing the Contractor a notice to proceed with the change. Until a notice to proceed is issued or a contract modification applies a VECP to this contract, the Contractor shall perform in accordance with the existing contract. The decision to accept or reject all or part of any VECP is a unilateral decision made solely at the discretion of the Contracting Officer.

(f) Sharing.

(1) Rates. The Government's share of savings is determined by subtracting Government costs from instant contract savings and multiplying the result by

(i) 45 percent for fixed-price contracts or

(ii) 75 percent for cost-reimbursement contracts.

(2) Payment. Payment of any share due the Contractor for use of a VECP on this contract shall be authorized by a modification to this contract to--

- (i) Accept the VECP;
- (ii) Reduce the contract price or estimated cost by the amount of instant contract savings; and
- (iii) Provide the Contractor's share of savings by adding the amount calculated to the contract price or fee.

(g) Collateral savings. If a VECP is accepted, the Contracting Officer will increase the instant contract amount by 20 percent of any projected collateral savings determined to be realized in a typical year of use after subtracting any Government costs not previously offset. However, the Contractor's share of collateral savings will not exceed the contract's firm-fixed-price or estimated cost, at the time the VECP is accepted, or \$100,000, whichever is greater. The Contracting Officer is the sole determiner of the amount of collateral savings.

(h) Subcontracts. The Contractor shall include an appropriate value engineering clause in any subcontract of \$50,000 or more and may include one in subcontracts of lesser value. In computing any adjustment in this contract's price under paragraph (f) above, the Contractor's allowable development and implementation costs shall include any subcontractor's allowable development and implementation costs clearly resulting from a VECP accepted by the Government under this contract, but shall exclude any value engineering incentive payments to a subcontractor. The Contractor may choose any arrangement for subcontractor value engineering incentive payments; provided, that these payments shall not reduce the Government's share of the savings resulting from the VECP.

(i) Data. The Contractor may restrict the Government's right to use any part of a VECP or the supporting data by marking the following legend on the affected parts:

"These data, furnished under the Value Engineering-- Construction clause of contract, shall not be disclosed outside the Government or duplicated, used, or disclosed, in whole or in part, for any purpose other than to evaluate a value engineering change proposal submitted under the clause. This restriction does not limit the Government's right to use information contained in these data if it has been obtained or is otherwise available from the Contractor or from another source without limitations." If a VECP is accepted, the Contractor hereby grants the Government unlimited rights in the VECP and supporting data, except that, with respect to data qualifying and submitted as limited rights technical data, the Government shall have the rights specified in the contract modification implementing the VECP and shall appropriately mark the data. (The terms "unlimited rights" and "limited rights" are defined in Part 27 of the Federal Acquisition Regulation.)

(End of clause)

52.249-2 TERMINATION FOR CONVENIENCE OF THE GOVERNMENT (FIXED-PRICE) (SEP 1996) - ALTERNATE I (SEP 1996)

(a) The Government may terminate performance of work under this contract in whole or, from time to time, in part if the Contracting Officer determines that a termination is in the Government's interest. The Contracting Officer shall terminate by delivering to the Contractor a Notice of Termination specifying the extent of termination and the effective date.

(b) After receipt of a Notice of Termination, and except as directed by the Contracting Officer, the Contractor shall immediately proceed with the following obligations, regardless of any delay in determining or adjusting any amounts due under this clause:

- (1) Stop work as specified in the notice.

(2) Place no further subcontracts or orders (referred to as subcontracts in this clause) for materials, services, or facilities, except as necessary to complete the continued portion of the contract.

(3) Terminate all subcontracts to the extent they relate to the work terminated.

(4) Assign to the Government, as directed by the Contracting Officer, all right, title, and interest of the Contractor under the subcontracts terminated, in which case the Government shall have the right to settle or to pay any termination settlement proposal arising out of those terminations.

(5) With approval or ratification to the extent required by the Contracting Officer, settle all outstanding liabilities and termination settlement proposals arising from the termination of subcontracts; the approval or ratification will be final for purposes of this clause.

(6) As directed by the Contracting Officer, transfer title and deliver to the Government (i) the fabricated or unfabricated parts, work in process, completed work, supplies, and other material produced or acquired for the work terminated, and (ii) the completed or partially completed plans, drawings, information, and other property that, if the contract had been completed, would be required to be furnished to the Government.

(7) Complete performance of the work not terminated.

(8) Take any action that may be necessary, or that the Contracting Officer may direct, for the protection and preservation of the property related to this contract that is in the possession of the Contractor and in which the Government has or may acquire an interest.

(9) Use its best efforts to sell, as directed or authorized by the Contracting Officer, any property of the types referred to in subparagraph (b)(6) of this clause; provided, however, that the Contractor (i) is not required to extend credit to any purchaser and (ii) may acquire the property under the conditions prescribed by, and at prices approved by, the Contracting Officer. The proceeds of any transfer or disposition will be applied to reduce any payments to be made by the Government under this contract, credited to the price or cost of the work, or paid in any other manner directed by the Contracting Officer.

(c) The Contractor shall submit complete termination inventory schedules no later than 120 days from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 120-day period.

(d) After expiration of the plant clearance period as defined in Subpart 45.6 of the Federal Acquisition Regulation, the Contractor may submit to the Contracting Officer a list, certified as to quantity and quality, of termination inventory not previously disposed of, excluding items authorized for disposition by the Contracting Officer. The Contractor may request the Government to remove those items or enter into an agreement for their storage. Within 15 days, the Government will accept title to those items and remove them or enter into a storage agreement. The Contracting Officer may verify the list upon removal of the items, or if stored, within 45 days from submission of the list, and shall correct the list, as necessary, before final settlement.

(e) After termination, the Contractor shall submit a final termination settlement proposal to the Contracting Officer in the form and with the certification prescribed by the Contracting Officer. The Contractor shall submit the proposal promptly, but no later than 1 year from the effective date of termination, unless extended in writing by the Contracting Officer upon written request of the Contractor within this 1-year period. However, if the Contracting Officer determines that the facts justify it, a termination settlement proposal may be received and acted on after 1 year or any extension. If the Contractor fails to submit the proposal within the time allowed, the Contracting Officer may determine, on the basis of information available, the amount, if any, due the Contractor because of the termination and shall pay the amount determined.

(f) Subject to paragraph (e) of this clause, the Contractor and the Contracting Officer may agree upon the whole or any part of the amount to be paid or remaining to be paid because of the termination. The amount may include a reasonable allowance for profit on work done. However, the agreed amount, whether under this paragraph (g) or paragraph (g) of this clause, exclusive of costs shown in subparagraph (g)(3) of this clause, may not exceed the total contract price as reduced by (1) the amount of payments previously made and (2) the contract price of work not terminated. The contract shall be modified, and the Contractor paid the agreed amount. Paragraph (g) of this clause shall not limit, restrict, or affect the amount that may be agreed upon to be paid under this paragraph.

(g) If the Contractor and Contracting Officer fail to agree on the whole amount to be paid the Contractor because of the termination of work, the Contracting Officer shall pay the Contractor the amounts determined as follows, but without duplication of any amounts agreed upon under paragraph (f) of this clause:

(1) For contract work performed before the effective date of termination, the total (without duplication of any items) of--

(i) The cost of this work;

(ii) The cost of settling and paying termination settlement proposals under terminated subcontracts that are properly chargeable to the terminated portion of the contract if not included in subdivision (g)(1)(i) of this clause; and

(iii) A sum, as profit on subdivision (g)(1)(i) of this clause, determined by the Contracting Officer under 49.202 of the Federal Acquisition Regulation, in effect on the date of this contract, to be fair and reasonable; however, if it appears that the Contractor would have sustained a loss on the entire contract had it been completed, the Contracting Officer shall allow no profit under this subdivision (iii) and shall reduce the settlement to reflect the indicated rate of loss.

(2) The reasonable costs of settlement of the work terminated, including--

(i) Accounting, legal, clerical, and other expenses reasonably necessary for the preparation of termination settlement proposals and supporting data;

(ii) The termination and settlement of subcontracts (excluding the amounts of such settlements); and

(iii) Storage, transportation, and other costs incurred, reasonably necessary for the preservation, protection, or disposition of the termination inventory.

(h) Except for normal spoilage, and except to the extent that the Government expressly assumed the risk of loss, the Contracting Officer shall exclude from the amounts payable to the Contractor under paragraph (g) of this clause, the fair value, as determined by the Contracting Officer, of property that is destroyed, lost, stolen, or damaged so as to become undeliverable to the Government or to a buyer.

(i) The cost principles and procedures of Part 31 of the Federal Acquisition Regulation, in effect on the date of this contract, shall govern all costs claimed, agreed to, or determined under this clause.

(j) The Contractor shall have the right of appeal, under the Disputes clause, from any determination made by the Contracting Officer under paragraph (e), (g), or (l) of this clause, except that if the Contractor failed to submit the termination settlement proposal or request for equitable adjustment within the time provided in paragraph (e) or (l), respectively, and failed to request a time extension, there is no right of appeal.

(k) In arriving at the amount due the Contractor under this clause, there shall be deducted--

(1) All unliquidated advance or other payments to the Contractor under the terminated portion of this contract;

(2) Any claim which the Government has against the Contractor under this contract; and

(3) The agreed price for, or the proceeds of sale of, materials, supplies, or other things acquired by the Contractor or sold under the provisions of this clause and not recovered by or credited to the Government.

(l) If the termination is partial, the Contractor may file a proposal with the Contracting Officer for an equitable adjustment of the price(s) of the continued portion of the contract. The Contracting Officer shall make any equitable adjustment agreed upon. Any proposal by the Contractor for an equitable adjustment under this clause shall be requested within 90 days from the effective date of termination unless extended in writing by the Contracting Officer.

(m)(1) The Government may, under the terms and conditions it prescribes, make partial payments and payments against costs incurred by the Contractor for the terminated portion of the contract, if the Contracting Officer believes the total of these payments will not exceed the amount to which the Contractor will be entitled.

(2) If the total payments exceed the amount finally determined to be due, the Contractor shall repay the excess to the Government upon demand, together with interest computed at the rate established by the Secretary of the Treasury under 50 U.S.C. App. 1215(b)(2). Interest shall be computed for the period from the date the excess payment is received by the Contractor to the date the excess is repaid. Interest shall not be charged on any excess payment due to a reduction in the Contractor's termination settlement proposal because of retention or other disposition of termination inventory until 10 days after the date of the retention or disposition, or a later date determined by the Contracting Officer because of the circumstances.

(n) Unless otherwise provided in this contract or by statute, the Contractor shall maintain all records and documents relating to the terminated portion of this contract for 3 years after final settlement. This includes all books and other evidence bearing on the Contractor's costs and expenses under this contract. The Contractor shall make these records and documents available to the Government, at the Contractor's office, at all reasonable times, without any direct charge. If approved by the Contracting Officer, photographs, microphotographs, or other authentic reproductions may be maintained instead of original records and documents.

(End of clause)

52.249-10 DEFAULT (FIXED-PRICE CONSTRUCTION) (APR 1984)

(a) If the Contractor refuses or fails to prosecute the work or any separable part, with the diligence that will insure its completion within the time specified in this contract including any extension, or fails to complete the work within this time, the Government may, by written notice to the Contractor, terminate the right to proceed with the work (or the separable part of the work) that has been delayed. In this event, the Government may take over the work and complete it by contract or otherwise, and may take possession of and use any materials, appliances, and plant on the work site necessary for completing the work. The Contractor and its sureties shall be liable for any damage to the Government resulting from the Contractor's refusal or failure to complete the work within the specified time, whether or not the Contractor's right to proceed with the work is terminated. This liability includes any increased costs incurred by the Government in completing the work.

(b) The Contractor's right to proceed shall not be terminated nor the Contractor charged with damages under this clause, if--

(1) The delay in completing the work arises from unforeseeable causes beyond the control and without the fault or negligence of the Contractor. Examples of such causes include

(i) acts of God or of the public enemy,

(ii) acts of the Government in either its sovereign or contractual capacity,

(iii) acts of another Contractor in the performance of a contract with the Government,

(iv) fires,

(v) floods,

(vi) epidemics,

(vii) quarantine restrictions,

(viii) strikes,

(ix) freight embargoes,

(x) unusually severe weather, or delays of subcontractors or suppliers at any tier arising from unforeseeable causes beyond the control and without the fault or negligence of both the Contractor and the subcontractors or suppliers; and

(2) The Contractor, within 10 days from the beginning of any delay (unless extended by the Contracting Officer), notifies the Contracting Officer in writing of the causes of delay. The Contracting Officer shall ascertain the facts and the extent of delay. If, in the judgment of the Contracting Officer, the findings of fact warrant such action, the time for completing the work shall be extended. The findings of the Contracting Officer shall be final and conclusive on the parties, but subject to appeal under the Disputes clause.

(c) If, after termination of the Contractor's right to proceed, it is determined that the Contractor was not in default, or that the delay was excusable, the rights and obligations of the parties will be the same as if the termination had been issued for the convenience of the Government.

The rights and remedies of the Government in this clause are in addition to any other rights and remedies provided by law or under this contract.

(End of clause)

52.252-4 ALTERATIONS IN CONTRACT (APR 1984)

Portions of this contract are altered as follows:

(End of clause)

52.253-1 COMPUTER GENERATED FORMS (JAN 1991)

(a) Any data required to be submitted on a Standard or Optional Form prescribed by the Federal Acquisition Regulation (FAR) may be submitted on a computer generated version of the form, provided there is no change to the name, content, or sequence of the data elements on the form, and provided the form carries the Standard or Optional Form number and edition date.

(b) Unless prohibited by agency regulations, any data required to be submitted on an agency unique form prescribed by an agency supplement to the FAR may be submitted on a computer generated version of the form provided there is no change to the name, content, or sequence of the data elements on the form and provided the form carries the agency form number and edition date.

(6) If the Contractor submits a computer generated version of a form that is different than the required form, then the rights and obligations of the parties will be determined based on the content of the required form.

(End of clause)

252.201-7000 CONTRACTING OFFICER'S REPRESENTATIVE (DEC 1991)

(a) "Definition. Contracting officer's representative" means an individual designated in accordance with subsection 201.602-2 of the Defense Federal Acquisition Regulation Supplement and authorized in writing by the contracting officer to perform specific technical or administrative functions.

(b) If the Contracting Officer designates a contracting officer's representative (COR), the Contractor will receive a copy of the written designation. It will specify the extent of the COR's authority to act on behalf of the contracting officer. The COR is not authorized to make any commitments or changes that will affect price, quality, quantity, delivery, or any other term or condition of the contract.

(End of clause)

252.203-7002 DISPLAY OF DOD HOTLINE POSTER (DEC 1991)

(a) The Contractor shall display prominently in common work areas within business segments performing work under Department of Defense (DoD) contracts, DoD Hotline Posters prepared by the DoD Office of the Inspector General.

(b) DoD Hotline Posters may be obtained from the DoD Inspector General, ATTN: Defense Hotline, 400 Army Navy Drive, Washington, DC 22202-2884.

(7) The Contractor need not comply with paragraph (a) of this clause if it has established a mechanism, such as a hotline, by which employees may report suspected instances of improper conduct, and instructions that encourage employees to make such reports.

(End of clause)

252.204-7003 CONTROL OF GOVERNMENT PERSONNEL WORK PRODUCT (APR 1992)

The Contractor's procedures for protecting against unauthorized disclosure of information shall not require Department of Defense employees or members of the Armed Forces to relinquish control of their work products, whether classified or not, to the contractor.

(End of clause)

252.209-7004 SUBCONTRACTING WITH FIRMS THAT ARE OWNED OR CONTROLLED BY THE GOVERNMENT OF A TERRORIST COUNTRY (MAR 1998)

(a) Unless the Government determines that there is a compelling reason to do so, the Contractor shall not enter into any subcontract in excess of \$25,000 with a firm, or subsidiary of a firm, that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country.

(b) A corporate officer or a designee of the Contractor shall notify the Contracting Officer, in writing, before entering into a subcontract with a party that is identified, on the List of Parties Excluded from Federal Procurement and Nonprocurement Programs, as being ineligible for the award of Defense contracts or subcontracts because it is owned or controlled by the government of a terrorist country. The notice must include the name of the proposed subcontractor notwithstanding its inclusion on the List of Parties Excluded From Federal Procurement and Nonprocurement Programs.

(End of clause)

252.215-7000 PRICING ADJUSTMENTS (DEC 1991)

The term "pricing adjustment," as used in paragraph (a) of the clauses entitled "Price Reduction for Defective Cost or Pricing Data - Modifications," "Subcontractor Cost or Pricing Data," and "Subcontractor Cost or Pricing Data - Modifications," means the aggregate increases and/or decreases in cost plus applicable profits.

(End of clause)

252.219-7003 SMALL, SMALL DISADVANTAGED AND WOMEN-OWNED SMALL BUSINESS SUBCONTRACTING PLAN (DOD CONTRACTS) (APR. 1996)

This clause supplements the Federal Acquisition Regulation 52.219-9, Small, Small Disadvantaged and Women-Owned Small Business Subcontracting Plan, clause of this contract.

(a) *Definitions. Historically black colleges and universities*, as used in this clause, means institutions determined by the Secretary of Education to meet the requirements of 34 CFR 608.2. The term also means any nonprofit research institution that was an integral part of such a college or university before November 14, 1986.

Minority institutions, as used in this clause, means institutions meeting the requirements of section 1046(3) of the Higher Education Act of 1965 (20 U.S.C. 1135d-5(3)). The term also includes Hispanic-serving institutions as defined in section 316(b)(1) of such Act (20 U.S.C. 1059c(b)(1)).

(b) Except for company or division-wide commercial items subcontracting plans, the term *small disadvantaged business*, when used in the FAR 52.219-9 clause, includes historically black colleges and universities and minority institutions, in addition to small disadvantaged business concerns.

(c) Work under the contract or its subcontracts shall be credited toward meeting the small disadvantaged business concern goal required by paragraph (d) of the FAR 52.219-9 clause when:

- (1) It is performed on Indian lands or in joint venture with an Indian tribe or a tribally-owned corporation, and
- (2) It meets the requirements of 10 U.S.C. 2323a.

(d) Subcontracts awarded to workshops approved by the Committee for Purchase from People Who are Blind or Severely Disabled (41 U.S.C. 46-48), may be counted toward the Contractor's small business subcontracting goal.

(e) A mentor firm, under the Pilot Mentor-Protege Program established under Section 831 of Pub. L. 101-510, as amended, may count toward its small disadvantaged business goal, subcontracts awarded--

(f) The master plan approval referred to in paragraph (f) of the FAR 52.219-9 clause is approval by the Contractor's cognizant contract administration activity.

(g) In those subcontracting plans which specifically identify small, small disadvantaged, and women-owned small businesses, the Contractor shall notify the Administrative Contracting Officer of any substitutions of firms that are not small, small disadvantaged, or women-owned small businesses for the firms listed in the subcontracting plan. Notifications shall be in writing and shall occur within a reasonable period of time after award of the subcontract. Contractor-specified formats shall be acceptable.

(End of clause)

252.223-7004 DRUG-FREE WORK FORCE (SEP 1988)

(a) Definitions.

(1) "Employee in a sensitive position," as used in this clause, means an employee who has been granted access to classified information; or employees in other positions that the Contractor determines involve national security; health or safety, or functions other than the foregoing requiring a high degree of trust and confidence.

(2) "Illegal drugs," as used in this clause, means controlled substances included in Schedules I and II, as defined by section 802(6) of title 21 of the United States Code, the possession of which is unlawful under chapter 13 of that Title. The term "illegal drugs" does not mean the use of a controlled substance pursuant to a valid prescription or other uses authorized by law.

(b) The Contractor agrees to institute and maintain a program for achieving the objective of a drug-free work force. While this clause defines criteria for such a program, contractors are encouraged to implement alternative approaches comparable to the criteria in paragraph (c) that are designed to achieve the objectives of this clause.

(c) Contractor programs shall include the following, or appropriate alternatives:

(1) Employee assistance programs emphasizing high level direction, education, counseling, rehabilitation, and coordination with available community resources;

(2) Supervisory training to assist in identifying and addressing illegal drug use by Contractor employees;

(3) Provision for self-referrals as well as supervisory referrals to treatment with maximum respect for individual confidentiality consistent with safety and security issues;

(4) Provision for identifying illegal drug users, including testing on a controlled and carefully monitored basis. Employee drug testing programs shall be established taking account of the following:

(i) The Contractor shall establish a program that provides for testing for the use of illegal drugs by employees in sensitive positions. The extent of and criteria for such testing shall be determined by the Contractor based on considerations that include the nature of the work being performed under the contract, the employee's duties, and efficient use of Contractor resources, and the risks to health, safety, or national security that could result from the failure of an employee adequately to discharge his or her position.

(ii) In addition, the Contractor may establish a program for employee drug testing--

(A) When there is a reasonable suspicion that an employee uses illegal drugs; or

(B) When an employees has been involved in an accident or unsafe practice;

(C) As part of or as a follow-up to counseling or rehabilitation for illegal drug use;

(D) As part of a voluntary employee drug testing program.

(iii) The Contractor may establish a program to test applicants for employment for illegal drug use.

(iv) For the purpose of administering this clause, testing for illegal drugs may be limited to those substances for which testing is prescribed by section 2.1 of subpart B of the "Mandatory Guidelines for Federal Workplace Drug Testing Programs" (53 FR 11980 (April 11, 1988), issued by the Department of Health and Human Services.

(d) Contractors shall adopt appropriate personnel procedures to deal with employees who are found to be using drugs illegally. Contractors shall not allow any employee to remain on duty or perform in a sensitive position who is found to use illegal drugs until such times as the Contractor, in accordance with procedures established by the Contractor, determines that the employee may perform in such a position.

(e) The provisions of this clause pertaining to drug testing program shall not apply to the extent that are inconsistent with state or local law, or with an existing collective bargaining agreement; provided that with respect to the latter, the Contractor agrees those issues that are in conflict will be a subject of negotiation at the next collective bargaining session.

(End of clause)

252.223-7006 PROHIBITION ON STORAGE AND DISPOSAL OF TOXIC AND HAZARDOUS MATERIALS (APR 1993)

(a) "Definitions".

As used in this clause --

(1) "Storage" means a non-transitory, semi-permanent or permanent holding, placement, or leaving of material. It does not include a temporary accumulation of a limited quantity of a material used in or a waste generated or resulting from authorized activities, such as servicing, maintenance, or repair of Department of Defense (DoD) items, equipment, or facilities.

(2) "Toxic or hazardous materials" means:

(i) Materials referred to in section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 U.S.C. 9601(14)) and materials designated under section 102 of CERCLA (42 U.S.C. 9602) (40 CFR part 302);

(ii) Materials that are of an explosive, flammable, or pyrotechnic nature; or

(iii) Materials otherwise identified by the Secretary of Defense as specified in DoD regulations.

(b) In accordance with 10 U.S.C. 2692, the Contractor is prohibited from storing or disposing of non-DoD-owned toxic or hazardous materials on a DoD installation, except to the extent authorized by a statutory exception to 10 U.S.C. 2692 or as authorized by the Secretary of Defense or his designee.

(End of clause)

252.226-7001 UTILIZATION OF INDIAN ORGANIZATIONS AND INDIAN-OWNED ECONOMIC ENTERPRISES-DOD CONTRACTS (SEP 2001)

(a) Definitions. As used in this clause--

“Indian” means any person who is a member of any Indian tribe, band, group, pueblo, or community that is recognized by the Federal Government as eligible for services from the Bureau of Indian Affairs (BIA) in accordance with 25 U.S.C. 1452(c) and any “Native” as defined in the Alaska Native Claims Settlement Act (43 U.S.C. 1601).

“Indian organization” means the governing body of any Indian tribe or entity established or recognized by the governing body of an Indian tribe for the purposes of 25 U.S.C. Chapter 17.

“Indian-owned economic enterprise” means any Indian-owned (as determined by the Secretary of the Interior) commercial, industrial, or business activity established or organized for the purpose of profit, provided that Indian ownership constitutes not less than 51 percent of the enterprise.

“Indian tribe” means any Indian tribe, band, group, pueblo, or community, including native villages and native groups (including corporations organized by Kenai, Juneau, Sitka, and Kodiak) as defined in the Alaska Native Claims Settlement Act, that is recognized by the Federal Government as eligible for services from BIA in accordance with 25 U.S.C. 1452 (c).

“Interested party” means a contractor or an actual or prospective offeror whose direct economic interest would be affected by the award of a subcontract or by the failure to award a subcontract.

(b) The Contract shall use its best efforts to give Indian organizations and Indian-owned economic enterprises the maximum practicable opportunity to participate in the subcontracts it awards, to the fullest extent consistent with efficient performance of the contract.

(c) The Contracting Officer and the Contractor, acting in good faith, may rely on the representation of an Indian organization or Indian-owned economic enterprise as to its eligibility, unless and interested party challenges its status or the Contracting Officer has independent reason to question that status.

(d) In the event of a challenge to the representation of a subcontractor, the Contracting Officer will refer the matter to the U.S. Department of the Interior, Bureau of Indian Affairs, Attn: Chief, Division of Contracting and Grants Administration, 1849 C Street NW, MS-2626-MIB, Washington, DC 20240-4000. The BIA will determine the eligibility and will notify the Contracting Officer. No incentive payment will be made--

(1) Within 59 working days of subcontract award;

(2) While a challenge is pending; or

(3) If a subcontractor is determined to be an ineligible participant.

(e)(1) The Contractor, on its own behalf or on behalf of a subcontractor at any tier, may request an adjustment under the Indian Incentive Program to the following:

- (i) The estimated cost of cost-type contract.
 - (ii) The target cost of a cost-plus-incentive-fee contract.
 - (iii) The target cost and ceiling price of a fixed-price incentive contract.
 - (iv) The price of a firm-fixed-price contract.
- (2) The amount of the adjustment that may be made to the contract is 5 percent of the estimated cost, target cost, or firm-fixed price included in the subcontract initially awarded to the Indian organization or Indian-owned economic enterprise.
- (3) The Contractor has the burden of proving the amount claimed and must assert its request for an adjustment prior to completion of contract performance.
- (4) The Contracting Officer, subject to the terms and conditions of the contract and the availability of funds, will authorize an incentive payment of 5 percent of the amount paid to the subcontractor.
- (5) If the Contractor requests and receives an adjustment on behalf of a subcontractor, the Contractor is obligated to pay the subcontractor the adjustment.
- (f) The Contractor shall insert the substance of this clause, including this paragraph (f), in all subcontracts that--
- (1) Are for other than commercial items; and
 - (2) Are expected to exceed the simplified acquisition threshold in Part 2 of the Federal Acquisition Regulation.
- (End of clause)

252.227-7033 RIGHTS IN SHOP DRAWINGS (APR 1966)

- (a) Shop drawings for construction means drawings, submitted to the Government by the Construction Contractor, subcontractor or any lower-tier subcontractor pursuant to a construction contract, showing in detail (i) the proposed fabrication and assembly of structural elements and (ii) the installation (i.e., form, fit, and attachment details) of materials or equipment. The Government may duplicate, use, and disclose in any manner and for any purpose shop drawings delivered under this contract.
- (b) This clause, including this paragraph (b), shall be included in all subcontracts hereunder at any tier.

252.231-7000 SUPPLEMENTAL COST PRINCIPLES (DEC 1991)

When the allowability of costs under this contract is determined in accordance with part 31 of the Federal Acquisition Regulation (FAR), allowability shall also be determined in accordance with part 231 of the Defense FAR Supplement, in effect on the date of this contract.

(End of clause)

252.236-7000 MODIFICATION PROPOSALS - PRICE BREAKDOWN. (DEC 1991)

(a) The Contractor shall furnish a price breakdown, itemized as required and within the time specified by the Contracting Officer, with any proposal for a contract modification.

(b) The price breakdown --

(1) Must include sufficient detail to permit an analysis of profit, and of all costs for --

(i) Material;

(ii) Labor;

(iii) Equipment;

(iv) Subcontracts; and

(v) Overhead; and

(2) Must cover all work involved in the modification, whether the work was deleted, added, or changed.

(c) The Contractor shall provide similar price breakdowns to support any amounts claimed for subcontracts.

(d) The Contractor's proposal shall include a justification for any time extension proposed.

252.242-7000 POSTAWARD CONFERENCE (DEC 1991)

The Contractor agrees to attend any postaward conference convened by the contracting activity or contract administration office in accordance with Federal Acquisition Regulation subpart 42.5.

(End of clause)

252.243-7001 PRICING OF CONTRACT MODIFICATIONS (DEC 1991)

When costs are a factor in any price adjustment under this contract, the contract cost principles and procedures in FAR part 31 and DFARS part 231, in effect on the date of this contract, apply.

252.243-7002 REQUESTS FOR EQUITABLE ADJUSTMENT (MAR 1998)

(a) The amount of any request for equitable adjustment to contract terms shall accurately reflect the contract adjustment for which the Contractor believes the Government is liable. The request shall include only costs for performing the change, and shall not include any costs that already have been reimbursed or that have been separately claimed. All indirect costs included in the request shall be properly allocable to the change in accordance with applicable acquisition regulations.

(b) In accordance with 10 U.S.C. 2410(a), any request for equitable adjustment to contract terms that exceeds the simplified acquisition threshold shall bear, at the time of submission, the following certificate executed by an individual authorized to certify the request on behalf of the Contractor:

I certify that the request is made in good faith, and that the supporting data are accurate and complete to the best of my knowledge and belief.

(Official's Name)

(Title)

(c) The certification in paragraph (b) of this clause requires full disclosure of all relevant facts, including--

(1) Cost or pricing data if required in accordance with subsection 15.403-4 of the Federal Acquisition Regulation (FAR); and

(2) Information other than cost or pricing data, in accordance with subsection 15.403-3 of the FAR, including actual cost data and data to support any estimated costs, even if cost or pricing data are not required.

(d) The certification requirement in paragraph (b) of this clause does not apply to----

(1) Requests for routine contract payments; for example, requests for payment for accepted supplies and services, routine vouchers under a cost-reimbursement type contract, or progress payment invoices; or

(2) Final adjustment under an incentive provision of the contract.

252.247-7023 TRANSPORTATION OF SUPPLIES BY SEA (MAY 2002)

(a) Definitions. As used in this clause --

(1) "Components" means articles, materials, and supplies incorporated directly into end products at any level of manufacture, fabrication, or assembly by the Contractor or any subcontractor.

(2) "Department of Defense" (DoD) means the Army, Navy, Air Force, Marine Corps, and defense agencies.

(3) "Foreign flag vessel" means any vessel that is not a U.S.-flag vessel.

(4) "Ocean transportation" means any transportation aboard a ship, vessel, boat, barge, or ferry through international waters.

(5) "Subcontractor" means a supplier, materialman, distributor, or vendor at any level below the prime contractor whose contractual obligation to perform results from, or is conditioned upon, award of the prime contract and who is performing any part of the work or other requirement of the prime contract.

(6) "Supplies" means all property, except land and interests in land, that is clearly identifiable for eventual use by or owned by the DoD at the time of transportation by sea.

(i) An item is clearly identifiable for eventual use by the DoD if, for example, the contract documentation contains a reference to a DoD contract number or a military destination.

(ii) "Supplies" includes (but is not limited to) public works; buildings and facilities; ships; floating equipment and vessels of every character, type, and description, with parts, subassemblies, accessories, and equipment; machine tools; material; equipment; stores of all kinds; end items; construction materials; and components of the foregoing.

(7) "U.S.-flag vessel" means a vessel of the United States or belonging to the United States, including any vessel registered or having national status under the laws of the United States.

(b)(1) The Contractor shall use U.S.-flag vessels when transporting any supplies by sea under this contract.

(2) A subcontractor transporting supplies by sea under this contract shall use U.S.-flag vessels if--

(i) This contract is a construction contract; or

(ii) The supplies being transported are--

(A) Noncommercial items; or

(B) Commercial items that--

(1) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it contracts for f.o.b. destination shipment);

(2) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(3) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(c) The Contractor and its subcontractors may request that the Contracting Officer authorize shipment in foreign-flag vessels, or designate available U.S.-flag vessels, if the Contractor or a subcontractor believes that --

(1) U.S.-flag vessels are not available for timely shipment;

(2) The freight charges are inordinately excessive or unreasonable; or

(3) Freight charges are higher than charges to private persons for transportation of like goods.

(d) The Contractor must submit any request for use of other than U.S.-flag vessels in writing to the Contracting Officer at least 45 days prior to the sailing date necessary to meet its delivery schedules. The Contracting Officer will process requests submitted after such date(s) as expeditiously as possible, but the Contracting Officer's failure to grant approvals to meet the shipper's sailing date will not of itself constitute a compensable delay under this or any other clause of this contract. Requests shall contain at a minimum --

(1) Type, weight, and cube of cargo;

(2) Required shipping date;

(3) Special handling and discharge requirements;

(4) Loading and discharge points;

(5) Name of shipper and consignee;

(6) Prime contract number; and

(7) A documented description of efforts made to secure U.S.-flag vessels, including points of contact (with names and telephone numbers) with at least two U.S.-flag carriers contacted. Copies of telephone notes, telegraphic and

facsimile message or letters will be sufficient for this purpose.

(e) The Contractor shall, within 30 days after each shipment covered by this clause, provide the Contracting Officer and the Maritime Administration, Office of Cargo Preference, U.S. Department of Transportation, 400 Seventh Street SW., Washington, DC 20590, one copy of the rated on board vessel operating carrier's ocean bill of lading, which shall contain the following information:

- (1) Prime contract number;
- (2) Name of vessel;
- (3) Vessel flag of registry;
- (4) Date of loading;
- (5) Port of loading;
- (6) Port of final discharge;
- (7) Description of commodity;
- (8) Gross weight in pounds and cubic feet if available;
- (9) Total ocean freight in U.S. dollars; and
- (10) Name of the steamship company.

(f) The Contractor shall provide with its final invoice under this contract a representation that to the best of its knowledge and belief--

- (1) No ocean transportation was used in the performance of this contract;
- (2) Ocean transportation was used and only U.S.-flag vessels were used for all ocean shipments under the contract;
- (3) Ocean transportation was used, and the Contractor had the written consent of the Contracting Officer for all non-U.S.-flag ocean transportation; or
- (4) Ocean transportation was used and some or all of the shipments were made on non-U.S.-flag vessels without the written consent of the Contracting Officer. The Contractor shall describe these shipments in the following format:

ITEM DESCRIPTION	CONTRACT LINE ITEMS	QUANTITY
_____	_____	_____
_____	_____	_____
_____	_____	_____
TOTAL _____		

(g) If the final invoice does not include the required representation, the Government will reject and return it to the Contractor as an improper invoice for the purposes of the Prompt Payment clause of this contract. In the event there has been unauthorized use of non-U.S.-flag vessels in the performance of this contract, the Contracting Officer is entitled to equitably adjust the contract, based on the unauthorized use.

(h) In the award of subcontracts for the types of supplies described in paragraph (b)(2) of this clause, the Contractor shall flow down the requirements of this clause as follows:

(1) The Contractor shall insert the substance of this clause, including this paragraph (h), in subcontracts that exceed the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(2) The Contractor shall insert the substance of paragraphs (a) through (e) of this clause, and this paragraph (h), in subcontracts that are at or below the simplified acquisition threshold in part 2 of the Federal Acquisition Regulation.

(End of clause)

252.247-7024 NOTIFICATION OF TRANSPORTATION OF SUPPLIES BY SEA (MAR 2000)

(a) The Contractor has indicated by the response to the solicitation provision, Representation of Extent of Transportation by Sea, that it did not anticipate transporting by sea any supplies. If, however, after the award of this contract, the Contractor learns that supplies, as defined in the Transportation of Supplies by Sea clause of this contract, will be transported by sea, the Contractor --

(1) Shall notify the Contracting Officer of that fact; and

(2) Hereby agrees to comply with all the terms and conditions of the Transportation of Supplies by Sea clause of this contract.

(b) The Contractor shall include this clause; including this paragraph (b), revised as necessary to reflect the relationship of the contracting parties--

(1) In all subcontracts under this contract, if this contract is a construction contract; or

(2) If this contract is not a construction contract, in all subcontracts under this contract that are for--

(i) Noncommercial items; or

(ii) Commercial items that--

(A) The Contractor is reselling or distributing to the Government without adding value (generally, the Contractor does not add value to items that it subcontracts for f.o.b. destination shipment);

(B) Are shipped in direct support of U.S. military contingency operations, exercises, or forces deployed in humanitarian or peacekeeping operations; or

(C) Are commissary or exchange cargoes transported outside of the Defense Transportation System in accordance with 10 U.S.C. 2643.

(End of clause)

Section 00800 - Special Contract Requirements (next page)

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SPECIAL CLAUSES

SC-1. COMMENCEMENT, PROSECUTION, AND COMPLETION OF WORK (APR 1984) (FAR 52.211-10).

The Contractor shall be required to (a) commence work under this Contract within 720 calendar days after the date the Contractor receives the notice to proceed, (b) prosecute the work diligently, and (c) complete the entire work ready for use not later than 720 calendar days after date of receipt by Contractor of notice to proceed. The time stated for completion shall include final cleanup of the premises.

SC-1.1 DELETED

SC-1.2 Exception to Completion Period(s): In case the Contracting Officer determines that completion of seeding, sodding, and planting, and establishment of same is not feasible within the completion period(s) stated above, the Contractor shall accomplish such work in the first planting period following the contract completion period and shall complete such work as specified, unless other planting periods are directed or approved by the Contracting Officer.

SC-2. LIQUIDATED DAMAGES - CONSTRUCTION (APR 1984) (FAR 52.211-12)

(a) If the Contractor fails to complete the work within the time specified in the Contract, or any extension, the Contractor shall pay to the Government as liquidated damages, the sum of \$2,830.00 for each day of delay.

(b) If the Government terminates the Contractor's right to proceed, the resulting damage will consist of liquidated damages until such reasonable time as may be required for final completion of the work together with any increased costs occasioned the Government in completing the work.

(c) If the Government does not terminate the Contractor's right to proceed, the resulting damage will consist of liquidated damages until the work is completed or accepted.

(d) Exception to Liquidated Damage: In case the Contracting Officer determines that completion of work stated above in paragraph Exception to Completion Period(s) is not feasible during the completion period(s) stated in SC-1, such work will be exempted from liquidated damages.

SC-3 DELETED.

SC-4. VARIATIONS IN ESTIMATED QUANTITIES - SUBDIVIDED ITEMS (MAR 1995) (EFARS 52.211-5001): This variation in estimated quantities clause is applicable only to Item No. 0011.

(a) Variation from the estimated quantity in the actual work performed under any second or subsequent sub-item or elimination of all work under such a second or subsequent sub-item will not be the basis for an adjustment in contract unit price.

(b) Where the actual quantity of work performed for Items No. 0011 is less than 85% of the quantity of the first sub-item listed under such item, the Contractor will be paid at the contract unit price for that sub-item for the actual quantity of work performed and, in addition, an equitable adjustment shall be made in accordance with the clause FAR 52.211-18, Variation in Estimated Quantities.

(c) If the actual quantity of work performed under Items No. 0011 exceeds 115 percent or is less than 85 percent of the total estimated quantity of the sub-item under that item and/or if the quantity of the work performed under the second sub-item or any subsequent sub-item under Items No. 0011 exceeds 115 % or is less than 85 % of the estimated quantity of any such sub-item, and if such variation causes an increase or a decrease in the time required for performance of this contract the contract completion time will be adjusted in accordance with the clause FAR 52.211-18, Variation in Estimated Quantities.

SC-5. INSURANCE - WORK ON A GOVERNMENT INSTALLATION (SEP 1989) (FAR 52.228-5)

(a) The Contractor shall, at its own expense, provide and maintain during the entire performance period of this Contract at least the kinds and minimum amounts of insurance required in the Insurance Liability Schedule or elsewhere in the Contract.

(b) Before commencing work under this Contract, the Contractor shall certify to the Contracting Officer in writing that the required insurance has been obtained. The policies evidencing required insurance shall contain an endorsement to the effect that any cancellation or any material change adversely affecting the Government's interest shall not be effective:

(1) for such period as the laws of the State in which this Contract is to be performed prescribe; or

(2) until 30 days after the insurer or the Contractor gives written notice to the Contracting Officer, whichever period is longer.

(c) The Contractor shall insert the substance of this clause, including this paragraph (c), in subcontracts under this Contract that require work on a Government installation and shall require subcontractors to provide and maintain the insurance required in the Schedule or elsewhere in the Contract. The Contractor shall maintain a copy of all subcontractors' proofs of required insurance, and shall make copies available to the Contracting Officer upon request.

(d) Insurance Liability Schedule (FAR 28.307-2)

(1) Workers' compensation and employer's liability. Contractors are required to comply with applicable Federal and State workers' compensation and occupational disease statutes. If occupational diseases are not compensable under those statutes, they shall be covered under the employer's liability section of the insurance policy, except when Contract operations are so commingled with a Contractor's commercial operation that it would not be practical to require this coverage. Employer's liability coverage of at least \$100,000 shall be required, except in states with exclusive or monopolistic funds that do not permit workers' compensation to be written by private carriers.

(2) General Liability.

(a) The Contracting Officer shall require bodily injury liability insurance coverage written on the comprehensive form of policy of at least \$500,000 per occurrence.

(b) Property damage liability insurance shall be required only in special circumstances as determined by the agency.

(3) Automobile liability. The Contracting Officer shall require automobile liability insurance written on the comprehensive form of policy. The policy shall provide for bodily injury and property damage liability covering the operation of all automobiles used in connection with performing the Contract. Policies covering automobiles operated in the United States shall provide coverage of at least \$200,000 per person and \$500,000 per occurrence for bodily injury and \$20,000 per occurrence for property damage. The amount of liability coverage on other policies shall be commensurate with any legal requirements of the locality and sufficient to meet normal and customary claims.

(4) Aircraft public and passenger liability. When aircraft are used in connection with performing the Contract, the Contracting Officer shall require aircraft public and passenger liability insurance. Coverage shall be at least \$200,000 per person and \$500,000 per occurrence for bodily injury, other than passenger liability, and \$200,000 per occurrence for property damage. Coverage for passenger liability bodily injury shall be at least \$200,000 multiplied by the number of seats or passengers, whichever is greater.

(5) Environmental Liability. If this contract includes the transport, treatment, storage, or disposal of hazardous material waste the following coverage is required.

The Contractor shall ensure the transporter and disposal facility have liability insurance in effect for claims arising out of the death or bodily injury and property damage from hazardous material/waste transport, treatment, storage and disposal, including vehicle liability and legal defense costs in the amount of \$1,000,000.00 as evidenced by a certificate of insurance for General, Automobile, and Environmental Liability Coverage. Proof of this insurance shall be provided to the Contracting Officer.

SC-6 DELETED.

SC-7. PERFORMANCE OF WORK BY THE CONTRACTOR (APR 1984) (FAR 52.236-1): The Contractor shall perform on the site, and with its own organization, work equivalent to at least fifteen percent (15%) of the total amount of work to be performed under the Contract. The percentage may be reduced by a supplemental agreement to this Contract if, during performing the work, the Contractor requests a reduction and the Contracting Officer determines that the reduction would be to the advantage of the Government.

SC-8. PHYSICAL DATA (APR 1984) (FAR 52.236-4): Data and information furnished or referred to below is for the Contractor's information. The Government will not be responsible for any interpretation of or conclusion drawn from the data or information by the Contractor.

(a) Physical Conditions: The indications of physical conditions on the drawings and in the specifications are the result of site investigations by test holes shown on the drawings.

(b) Weather Conditions: Each bidder shall be satisfied before submitting his bid as to the hazards likely to arise from weather conditions. Complete weather records and reports may be obtained from any National Weather Service Office.

(c) Transportation Facilities: Each bidder, before submitting his bid, shall make an investigation of the conditions of existing public and private roads and of clearances, restrictions, bridge load limits, and other limitations affecting transportation and ingress and egress at the jobsite. The unavailability of transportation facilities or limitations thereon shall not become a basis for claims for damages or extension of time for completion of the work.

SC-9 DELETED.

SC-10. LAYOUT OF WORK (APR 1984) (FAR 52.236-17): The Contractor shall lay out its work from Government-established base lines and bench marks indicated on the drawings, and shall be responsible for all measurements in connection with the layout. The Contractor shall furnish, at its own expense, all stakes, templates, platforms, equipment, tools, materials, and labor required to lay out any part of the work. The Contractor shall be responsible for executing the work to the lines and grades that may be established or indicated by the Contracting Officer. The Contractor shall also be responsible for maintaining and preserving all stakes and other marks established by the Contracting Officer until authorized to remove them. If such marks are destroyed by the Contractor or through its negligence before their removal is authorized, the Contracting Officer may replace them and deduct the expense of the replacement from any amounts due, or to become due, to the Contractor.

SC-11 THROUGH SC-12 DELETED.

SC-13. IDENTIFICATION OF GOVERNMENT-FURNISHED PROPERTY (APR 1984) (FAR 52.245-3): The Government will furnish to the Contractor the property identified in the schedule to be incorporated or installed into the work or used in performing the contract. The listed property will be furnished to the Contractor at the place designated by the Contracting Officer. The Contractor is required to accept delivery, pay any demurrage or detention charges, and unload and transport the property to the jobsite at its own expense. When the property is delivered, the Contractor shall verify its quantity and condition and acknowledge receipt in writing to the Contracting Officer. The Contractor shall also report in writing to the Contracting Officer within 24 hours of delivery any damage to or shortage of the property as received. All such property shall be installed or incorporated into the work at the expense of the Contractor, unless otherwise indicated in this contract.

For purposes of calculating the amount of Washington State Use Tax to be included in his bid; the Contractor shall use an estimated value of \$43,500.00 for Government-furnished Contractor-installed (GF/CI) equipment/property. Ultimately the actual cost of equipment furnished will be used to adjust the final contract amount by modification to reflect the user tax excluding Contractor markups, actually paid by the Contractor for GF/CI equipment schedule.

SCHEDULE

<u>QUANTITY</u>	<u>ITEM</u>	<u>DESCRIPTION</u>	<u>EST. VALUE</u> <u>(TOTAL)</u>
24	Washing Machines		\$24, 000
5	Heavy Duty Washing Machines		\$7,500
24	Clothes Dryers		\$12,000

SC-14. EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE (MAR 1995)-(EFARS 52.231-5000)

(a) This clause does not apply to terminations. See 52.249-5000, Basis for Settlement of Proposals and FAR Part 49.

(b) Allowable cost for construction and marine plant and equipment in sound workable condition owned or controlled and furnished by a contractor or subcontractor at any tier shall be based on actual cost data for each piece of equipment or groups of similar serial and series for which the Government can determine both ownership and operating costs from the contractor's accounting records. When both ownership and operating costs cannot be determined for any piece of equipment or groups of similar serial or series equipment from the contractor's accounting records, costs for that equipment shall be based upon the applicable provisions of EP 1110-1-8, Construction Equipment Ownership and Operating Expense Schedule, Region VIII. Working conditions shall be considered to be average for determining equipment rates using the schedule unless specified otherwise by the contracting officer. For equipment not included in the schedule, rates for comparable pieces of equipment may be used or a rate may be developed using the formula provided in the schedule. For forward pricing, the schedule in effect at the time of negotiations shall apply. For retroactive pricing, the schedule in effect at the time the work was performed shall apply.

(c) Equipment rental costs are allowable, subject to the provisions of FAR 31.105(d)(ii) and FAR 31.205-36. Rates for equipment rented from an organization under common control, lease-purchase arrangements, and sale-leaseback arrangements, will be determined using the schedule, except that actual rates will be used for equipment leased from an organization under common control that has an established practice of leasing the same or similar equipment to unaffiliated lessees.

(d) When actual equipment costs are proposed and the total amount of the pricing action exceeds the small purchase threshold, the contracting officer shall request the contractor to submit either certified cost or pricing data, or partial/limited data, as appropriate. The data shall be submitted on Standard Form 1411, Contract Pricing Proposal Cover Sheet.

(e) Copies of EP1110-1-8 "Construction Equipment Ownership and Operating Expense Schedule" Volumes 1 through 12 are available in Portable Document Format (PDF) and can be viewed or downloaded at <http://www.usace.army.mil/inet/usace-docs/eng-pamphlets/cecw.htm>. A CD-ROM containing (Volumes 1-12) is available through either the Superintendent of

Documents or Government bookstores. For additional information telephone 202-512-2250, or access on the Internet at http://www.access.gpo.gov/su_docs.

SC-15. PAYMENT FOR MATERIALS DELIVERED OFF-SITE (MAR 1995)-(EFARS 52.232-5000)

(a) Pursuant to FAR clause 52.232-5, Payments Under Fixed Priced Construction Contracts, materials delivered to the contractor at locations other than the site of the work may be taken into consideration in making payments if included in payment estimates and if all the conditions of the General Provisions are fulfilled. Payment for items delivered to locations other than the work site will be limited to: (1) materials required by the technical provisions; or (2) materials that have been fabricated to the point where they are identifiable to an item of work required under this contract.

(b) Such payment will be made only after receipt of paid or receipted invoices or invoices with canceled check showing title to the items in the prime contractor and including the value of material and labor incorporated into the item. In addition to petroleum products, payment for materials delivered off-site is limited to the following items: Any other construction material stored offsite may be considered in determining the amount of a progress payment.

SC-16 AND SC-17 DELETED.

SC-18. CONTRACT DRAWINGS, MAPS, AND SPECIFICATIONS (OCT 1996) (52.0236-4001 EBS)

(a) The Government--

(1) Will provide the Contractor, without charge, one set of contract drawings and one set of specifications in electronic format on a compact disk. The Government will not give the Contractor any hard copy paper drawings or specifications for any contract resulting from this solicitation.

(b) The Contractor shall--

(1) check all drawings furnished immediately upon receipt;

(2) Compare all drawings and verify the figures before laying out the work;

(3) Promptly notify the Contracting Officer of any discrepancies; and

(4) Be responsible for any errors which might have been avoided by complying with this paragraph (b).

(c) Large scale drawings shall, in general, govern small scale drawings. Figures marked on drawings shall, in general, be followed in preference to scale measurements.

(d) Omissions from the drawings or specifications or the misdescription of details of work which are manifestly necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such

omitted or misdescribed details of the work, but shall be performed as if fully and correctly set forth and described in the drawings and specifications.

(e) The work shall conform to the specifications and the contract drawings identified in the index of drawings attached at the end of the Special Clauses.

SC-19 THROUGH SC-21 DELETED.

SC-22. EPA ENERGY STAR: The Government requires that certain equipment be Energy Star compliant. Initially, the sole Energy Star requirement shall be the self certification by the bidder that the specified equipment is Energy Star compliant. Within 3 months of the availability of an EPA sanctioned test for Energy Star compliance, the Contractor shall submit all equipment upgrades and additions for testing and provide proof of compliance to the Government upon completion of testing. Testing shall be at the Contractor's expense.

SC-23. RECOVERED MATERIALS: The Corps of Engineers encourages all bidders to utilize recovered materials to the maximum extent practicable. The attached APPENDIX R contains procurement guidelines for products containing recovered materials.

APPENDIX R

PART 247 - COMPREHENSIVE PROCUREMENT GUIDELINE FOR PRODUCTS CONTAINING RECOVERED MATERIALS

40 CFR Ch. 1 (9-1-99 Edition)

Subpart B-Item Designations

§ 247.10 Paper and paper products.

Paper and paper products, excluding building and construction paper grades.

§ 247.11 Vehicular products.

- (a) Lubricating oils containing re-refined oil, including engine lubricating oils, hydraulic fluids, and gear oils, excluding marine and aviation oils.
- (b) Tires, excluding airplane tire
- (e) Reclaimed engine coolants, excluding coolants used in non-vehicular applications.

247.12 Construction products.

- (a) Building insulation product including the following items:
 - (1) Loose-fill insulation, including but not limited to cellulose fiber, mineral fibers (fiberglass and rock vermiculite, and perlite;
 - (2) Blanket and batt insulation, including but not limited to mineral fibers (fiberglass and rock wool).
 - (3) Board (sheathing, roof decking wall panel) insulation, including but not limited to structural fiberboard and laminated paperboard products perlite composite board, polyurethane, polyisocyanurate, polystyrene, phenolics, and composites; and
 - (4) Spray-in-place insulation, including but not limited to foam-in-place polyurethane and polyisocyanurate and spray-on cellulose.
- (b) Structural fiberboard and laminated paperboard products for applications other than building insulation, including building board, sheathing shingle backer, sound deadening board, roof insulating board, insulating wallboard, acoustical and non-acoustical ceiling tile, acoustical and non-acoustical lay-in panels, floor underlayments, and roof overlay (cover board).
- (c) Cement and concrete, including concrete products such as pipe and block, containing coal fly as ground granulated blast furnace (GGBF) slag.
- (d) Carpet made of polyester fiber use in low- and medium-wear applications.
- (e) Floor tiles and patio block containing recovered rubber or plastic.
- (f) Shower and restroom dividers/partitions containing recovered plastic or steel.
- (g) (1) Consolidated latex paint used for covering graffiti; and
- (2) Reprocessed latex paint used for interior and exterior architectural applications such as wallboard, ceilings, and trim; gutter boards; and concrete, stucco, masonry, wood and metal surfaces.

§247.13 Transportation products.

- (a) Traffic barricades and traffic cones used in controlling or restricting vehicular traffic.

- (b) Parking stops made from concrete or containing recovered plastic or rubber.
- (c) Channelizers containing recovered plastic or rubber.
- (d) Delineators containing recovered plastic, rubber, or steel.
- (e) Flexible delineators containing recovered plastic.

§ 247.14 Park and recreation products

- (a) Playground surfaces and running tracks containing recovered rubber or plastic.
- (b) Plastic fencing containing recovered plastic for use in controlling snow or sand drifting and as a warning/safety barrier in construction or other applications.

247.15 Landscaping products.

- (a) Hydraulic mulch products containing recovered paper or recovered wood used for hydroseeding and as an over-spray for straw mulch in landscaping, erosion control, and soil reclamation.
- (b) Compost made from yard trimmings, leaves, and/or grass clippings for use in landscaping, seeding of grass or other plants on roadsides and embankments, as a nutritious mulch under trees and shrubs, and in erosion control and soil reclamation.
- (c) Garden and soaker hoses containing recovered plastic or rubber.
- (d) Lawn and garden edging containing recovered plastic or rubber.

§ 247.16 Non-paper office product.

- (a) Office recycling containers and office waste receptacles.
- (b) Plastic desktop accessories.
- (c) Toner cartridges.
- (d) Binders.
- (e) Plastic trash bags.
- (f) Printer ribbons.
- (g) Plastic envelopes.

§ 247.17 Miscellaneous products.

Pallets containing recovered wood, plastic, or paperboard.

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FORT LEWIS, WASHINGTON
PN 41884
22s/721-12-14

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214	P102	Barrack A (North) Second Floor Plumbing Plan		03JAN03
215	P103	Barrack A (North) Third Floor Plumbing Plan		03JAN03
216	P104	Barrack B (North) First Floor Plumbing Plan		03JAN03
217	P105	Barrack B (North) Second Floor Plumbing Plan		03JAN03
218	P106	Barrack B (North) Third Floor Plumbing Plan		03JAN03
219	P107	Barrack C (North) First Floor Plumbing Plan		03JAN03
220	P108	Barrack C (North) Second Floor Plumbing Plan		03JAN03
221	P109	Barrack C (North) Third Floor Plumbing Plan		03JAN03
222	P110	Barrack A (North) First Floor Foundation Sanitary Sewer		03JAN03
223	P111	Barrack B (North) First Floor Foundation Sanitary Sewer		03JAN03
224	P112	Barrack C (North) First Floor Foundation Sanitary Sewer		03JAN03
225	P113	Barrack C (North) Third Floor Attic Sanitary Sewer Vent		03JAN03
226	P114	Barrack B (North) Third Floor Attic Sanitary Sewer Vent		03JAN03
227	P115	Barrack C (North) Second Floor Attic Sanitary Sewer Vent		03JAN03

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229	P117	Barrack A (South) First Floor Plumbing Plan		03JAN03
230	P118	Barrack A (South) Second Floor Plumbing Plan		03JAN03
231	P119	Barrack A (South) Third Floor Plumbing Plan		03JAN03
232	P120	Barrack B (South) First Floor Plumbing Plan		03JAN03
233	P121	Barrack B (South) Second Floor Plumbing Plan		03JAN03
234	P122	Barrack B (South) Third Floor Plumbing Plan		03JAN03
235	P123	Barrack C (South) First Floor Plumbing Plan		03JAN03
236	P124	Barrack C (South) Second Floor Plumbing Plan		03JAN03
237	P125	Barrack C (South) Third Floor Plumbing Plan		03JAN03
238	P126	Barrack A (South) First Floor Foundation Sanitary Sewer		03JAN03
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268	M103	Barrack A (North) Second Floor HVAC Plan		03JAN03
269	M104	Barrack A (North) Third Floor HVAC Plan		03JAN03
270	M105	Barrack A (North) Attic Space HVAC Plan		03JAN03
271	M106	Barrack B (North) First Floor HVAC Plan		03JAN03
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279	M114	Composite (South) Hydronic Piping Plan		03JAN03
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287	M122	Barrack B (South) Attic Space HVAC Plan		03JAN03
288	M123	Barrack C (South) First Floor HVAC Plan		03JAN03
289	M124	Barrack C (South) Second Floor HVAC Plan		03JAN03
290	M125	Barrack C (South) Third Floor HVAC Plan		03JAN03
291	M126	Barrack C (South) Attic Space HVAC Plan		03JAN03
292	M127	SCB (North) HVAC Plan		03JAN03
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295	M130	SCB (North) HVAC Laundry		03JAN03
296	M131	SCB (South) HVAC Plan		03JAN03
297	M132	SCB (South) HVAC Supply Plan		03JAN03
298	M133	SCB (South) HVAC Return and Exhaust Plan		03JAN03
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327	E110	Barrack C (North) Second Floor Power		03JAN03
328	E111	Barrack C (North) Third Floor Power		03JAN03
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330	E113	SCB (North) Power Plan		03JAN03
331	E114	Barrack A (South) First Floor Power		03JAN03
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333	E116	Barrack A (South) Third Floor Power		03JAN03
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49	S504	Steel Details		03JAN03
50	S505	Steel Details		03JAN03
51	S506	Steel Details		03JAN03
52	S507	Steel Details		03JAN03
53	S508	Steel Details		03JAN03
54	S509	Steel Details		03JAN03
55	S701	Stair Framing Details		03JAN03
56	M001	Mechanical Legend & General Notes		03JAN03
57	M002	Control Abbreviations & Symbols		03JAN03
58	M003	Schedules		03JAN03
59	M004	Schedules		03JAN03
60	M201	Plumbing Foundation Plan		03JAN03
61	M301	Plumbing First Floor Plan		03JAN03
62	M302	Plumbing Second Floor Plan		03JAN03
63	M303	Enlarged Plumbing Floor Plans		03JAN03
64	M304	Plumbing Details		03JAN03
65	M401	Hydronic First Floor Plan		03JAN03
66	M402	Hydronic Second Floor Plan		03JAN03
67	M403	Boiler Schematic		03JAN03
68	M404	Hydronic Details		03JAN03
69	M501	Heating & Ventilating First Floor Plan		03JAN03
70	M502	Heating & Ventilating Second Floor Plan		03JAN03
71	M503	Enlarged HVAC Floor Plans		03JAN03
72	M504	Sections		03JAN03
73	M505	HVAC Details		03JAN03
74	M601	Control Schematics		03JAN03
75	M602	Control Schematics		03JAN03
76	F701	Fire Protection Plan		03JAN03
77	E001	"Legends, Notes"		03JAN03
78	E002	"Legend, Abbreviation List"		03JAN03
79	E201	First Floor Lighting Plan		03JAN03

SHEET NUMBER	PLATE NUMBER	TITLE	REVISION NUMBER	DATE
80	E202	Second Floor Lighting Plan		03JAN03
81	E301	First Floor Power Plan		03JAN03
82	E302	Second Floor Power Plan		03JAN03
83	E401	First Floor Signal Plan		03JAN03
84	E402	Second Floor Signal Plan		03JAN03
85	E501	Building Riser Diagrams		03JAN03
86	E502	Building Riser Diagrams		03JAN03
87	E601	Light Fixture Schedule		03JAN03
88	E602	Lighting Details 1		03JAN03
89	E603	Lighting Details 2		03JAN03
90	E604	Panel Schedules		03JAN03
91	E605	Panel Schedules		03JAN03
92	E701	Details		03JAN03
93	E702	Building Enlarged Plans		03JAN03

STANDARD DETAILS BOUND IN THE SPECIFICATIONS

DRAWING NUMBER	SHEET NUMBER	TITLE	DATE
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SECTION 01501 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

1 & 2	U.S. Army Project Construction Sign	84JUN20
1	Hard Hat Sign	10SEP90


END OF SECTION


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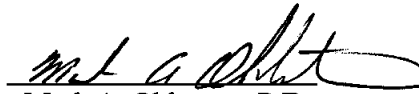
DESIGN AUTHENTICATION


FY03 WHOLE BARRACKS RENEWAL, FT. LEWIS, WA

Signatures affixed below indicate the drawings and specifications included in this solicitation were prepared, reviewed and certified in accordance with Department of Army Engineer Regulation ER 1110-345-100, DESIGN POLICY FOR MILITARY CONSTRUCTION.

FOR  *John J. Zabunover P.E.*
Dean M. Schmidt
Chief, Tech. Eng. & Review Section,
Construction Branch


Thomas Poole, P.E.
Project Manager


Mark A. Ohlstrom, P.E.
Chief, Design Branch


Rick L. Moshier, P.E.
Chief, Engineering & Construction Division

This project was designed by the U.S. Army Corps of Engineers, Seattle District. The initials and/or signatures and registration designations of individuals appearing on these project documents are within the scope of their employment as required by ER 1110-1-8152, ENGINEERING AND DESIGN PROFESSIONAL REGISTRATION.

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DAVIS-BACON GENERAL WAGE DECISIONS:

a) **WA020001 (Heavy and Highway)** - All work more than 5 feet (1.5 meters) from the perimeter of a building shall be performed under this wage decision.

b) **WA020002 (Building)** - All work inside and within 5 feet (1.5 meters) of all buildings other than the three-story, three-hundred person barracks building shall be performed under this wage decision.

b) **WA020014 (Residential)** – All work all work inside and within 5 feet (1.5 meters) of the three-story, three hundred person barracks shall be performed under this wage decision.

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GENERAL DECISION **WA020001** 01/17/2003 WA1

Date: January 17, 2003
General Decision Number **WA020001**

Superseded General Decision No. WA010001

State: Washington

Construction Type:
DREDGING
HEAVY
HIGHWAY

County(ies):
STATEWIDE

HEAVY AND HIGHWAY AND DREDGING CONSTRUCTION PROJECTS
(Excludes D.O.E. Hanford Site in Benton and Franklin
Counties)

Modification Number	Publication Date
0	03/01/2002
1	03/08/2002
2	03/15/2002
3	03/29/2002
4	04/19/2002
5	05/03/2002
6	05/10/2002
7	06/07/2002
8	06/21/2002
9	07/05/2002
10	07/19/2002
11	07/26/2002
12	08/09/2002
13	09/06/2002
14	09/27/2002
15	01/03/2003
16	01/17/2003

COUNTY(ies):
STATEWIDE

CARP0001W 06/01/2002

Rates

Fringes

COLUMBIA RIVER AREA - ADAMS, BENTON, COLUMBIA, DOUGLAS
(EAST OF
THE 120TH MERIDIAN), FERRY, FRANKLIN, GRANT, OKANOGAN (EAST
OF
THE 120TH MERIDIAN) AND WALLA WALLA COUNTIES

CARPENTERS:

GROUP 1:	23.58	6.25
GROUP 2:	24.69	6.25
GROUP 3:	23.85	6.25
GROUP 4:	23.58	6.25
GROUP 5:	58.43	6.25
GROUP 6:	27.72	6.25

SPOKANE AREA: ASOTIN, GARFIELD, LINCOLN, PEND OREILLE,
SPOKANE,
STEVENS AND WHITMAN COUNTIES

CARPENTERS:

GROUP 1:	22.91	6.25
GROUP 2:	24.01	6.25
GROUP 3:	23.17	6.25
GROUP 4:	22.91	6.25
GROUP 5:	56.77	6.25
GROUP 6:	27.00	6.25

CARPENTERS CLASSIFICATIONS

GROUP 1: Carpenter; Burner-Welder; Rigger and Signaler;
Insulators (all types), Acoustical, Drywall and Metal
Studs,

Metal Panels and Partitions; Floor Layer, Sander, Finisher
and

Astro Turf; Layout Carpenters; Form Builder; Rough Framers;
Outside or Inside Finisher, including doors, windows, and
jams;

Sawfiler; Shingler (wood, composition) Solar, Fiberglass,
Aluminum or Metal; Scaffold Erecting and Dismantling;
Stationary

Saw-Off Bearer; Wire, Wood and Metal Lather Applicator

GROUP 2: Millwright, machine erector

GROUP 3: Piledriver - includes driving, pulling, cutting,
placing collars, setting, welding, or creosote treated
material,

on all piling

GROUP 4: Bridge, dock and wharf carpenters

GROUP 5: Divers
GROUP 6: Divers Tender

DEPTH PAYY FOR DIVERS:

Each foot over 50-100 feet	\$1.00
Each foot over 100-175 feet	2.25
Each foot over 175-250 feet	5.50

HAZMAT PROJECTS

Anyone working on a HAZMAT job (task), where HAZMAT certification is required, shall be compensated at a premium, in addition to the classification working in as follows:

LEVEL D + \$.25 per hour - This is the lowest level of protection.
No respirator is used and skin protection is minimal.

LEVEL C + \$.50 per hour - This level uses an air purifying respirator or additional protective clothing.
LEVEL B + \$.75 per hour - Uses same respirator protection as Level A. Supplied air line is provided in conjunction with a chemical "splash suit".

LEVEL A +\$1.00 per hour - This level utilizes a fully encapsulated suit with a self-contained breathing apparatus or a supplied air line.

CARP00030 06/01/2002

Rates

Fringes
SOUTHWEST WASHINGTON: CLARK, COWLITZ, KLICKITAT, LEWIS(Piledriver only), PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to Willapa Bay to the Pacific Ocean), SKAMANIA AND WAHAKIAKUM COUNTIES and INCLUDES THE ENTIRE PENINSULA WEST OF WILLAPA BAY

SEE ZONE DESCRIPTION FOR CITIES BASE POINTS

ZONE 1:

CARPENTERS; ACOUSTICAL	27.37	8.80
DRYWALL	27.37	8.80
FLOOR LAYERS & FLOOR FINISHERS (the laying of all hardwood floors nailed and mastic set, parquet and wood-type tiles, and block floors, the sanding and finishing of floors, the preparation of old and new floors when the materials mentioned above are to be installed); INSULATORS (fiberglass and similar irritating materils	27.52	8.80
MILLWRIGHTS	27.87	8.80
PILEDRIVERS	27.87	8.80
DIVERS	65.05	8.80
DIVERS TENDERS	29.91	8.80

DEPTH PAY

50 TO 100 FEET	\$1.00 PER FOOT OVER 50 FEET
100 TO 150 FEET	1.50 PER FOOT OVER 100 FEET
150 TO 200 FEET	2.00 PER FOOT OVER 150 FEET

Zone Differential (Add up Zone 1 rates):

Zone 2 - \$0.85

Zone 3 - 1.25

Zone 4 - 1.70

Zone 5 - 2.00

Zone 6 - 3.00

BASEPOINTS: ASTORIA, LONGVIEW, PORTLAND, THE DALLES,
AND VANCOUVER, (NOTE: All dispatches for Washington State
Counties: Cowlitz, Wahkiakum and Pacific shall be from
Longview

Local #1707 and mileage shall be computed from that point.)

ZONE 1: Projects located within 30 miles of the respective
city hall of the above mentioned cities

ZONE 2: Projects located more than 30 miles and less than
40
miles of the respective city of the above mentioned
cities

ZONE 3: Projects located more than 40 miles and less than
50
miles of the respective city of the above mentioned
cities

ZONE 4: Projects located more than 50 miles and less than 60

miles of the respective city of the above mentioned cities.

ZONE 5: Projects located more than 60 miles and less than 70

miles of the respective city of the above mentioned cities

ZONE 6: Projects located more than 70 miles of the respected

city of the above mentioned cities

CARP0770D 06/01/2002

Rates

Fringes

WESTERN WASHINGTON: CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON,

KING, KITSAP, LEWIS (excludes piledrivers only), MASON, PACIFIC (North of a straight line made by extending the north

boundary line of Wahkiakum County west to the Pacific Ocean),

PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM COUNTIES

CARPENTERS AND DRYWALL APPLICATORS	27.95	8.05
CARPENTERS ON CREOSOTE MATERIAL	28.05	8.05
INSULATION APPLICATORS	25.50	8.05
SAWFILERS, STATIONARY POWER SAW OPERATORS, FLOOR FINISHER, FLOOR LAYER, SHINGLER, FLOOR SANDER OPERATOR AND OPERATORS OF OTHER STATIONARY WOOD WORKING TOOLS	28.08	8.05
MILLWRIGHT AND MACHINE ERECTORS	28.95	8.05
ACOUSTICAL WOKRERS	28.11	8.05
PILEDRIIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING	28.15	8.05
PILEDRIIVER, BRIDGE, DOCK & WHARF CARPENTERS	27.95	8.05
DIVERS	68.97	8.05
DIVERS TENDER	30.68	8.05

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON - ALL

CLASSIFICATIONS EXCEPT MILLWRIGHTS AND PILEDRIVERS

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay	
0 -25 radius miles	Free
25-35 radius miles	\$1.00/hour
35-45 radius miles	\$1.15/hour
45-55 radius miles	\$1.35/hour
Over 55 radius miles	\$1.55/hour

(HOURLY ZONE PAY: WESTERN AND CENTRAL WASHINGTON -
MILLWRIGHT AND
PILEDRIVER ONLY)

Hourly Zone Pay shall be computed from Seattle Union
Hall, Tacoma City center, and Everett City center

Zone Pay	
0 -25 radius miles	Free
25-45 radius miles	\$.70/hour
Over 45 radius miles	\$1.50/hour

CENTRAL WASHINGTON: CHELAN, DOUGLAS (WEST OF THE 120TH
MERIDIAN),
KITITITAS, OKANOGAN (WEST OF THE 120TH MERIDIAN) AND YAKIMA
COUNTIES

CARPENTERS AND DRYWALL APPLICATORS	20.72	7.82
CARPENTERS ON CREOSOTED MATERIAL	20.82	7.82
INSULATION APPLICATORS	20.72	7.82
SAWFILERS, STATIONARY POWER S37 OPERATORS, FLOOR FINISHER, FLOOR LAYER, SHINGLERS, FLOOR SANDER OPERATORS	20.85	7.82
MILLWRIGHT AND MACHINE ERECTORS	28.95	7.82
PILEDRIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE		

TREATED MATERIAL, ALL PILING PILEDRIIVER, BRIDGE DOCK AND WHARF CARPENTERS	28.15	7.82
DIVERS	27.95	7.82
DIVERS TENDER	68.97	8.05
	30.68	8.05

ELEC0046A 12/30/2002

Rates

Fringes
CALLAM, JEFFERSON, KING AND KITSAP COUNTIES

ELECTRICIANS	31.50	
3%+8.88		
CABLE SPLICERS	34.65	
3%+8.88		

ELEC0048C 01/01/2003

Rates

Fringes
CLARK, KLICKITAT AND SKAMANIA COUNTIES

ELECTRICIANS	31.00	
3%+11.83		
CABLE SPLICERS	31.25	
3%+11.83		

ELEC0073A 07/01/2002

Rates

Fringes
ADAMS, FERRY, LINCOLN, PEND OREILLE, SPOKANE, STEVENS,
WHITMAN
COUNTIES

ELECTRICIANS	23.82	3%+
9.58		
CABLE SPLICERS	24.22	3%+
9.58		

ELEC0076B 07/01/2002

	Rates
Fringes	
GRAYS HARBOR, LEWIS, MASON, PACIFIC, PIERCE, AND THURSTON COUNTIES	
ELECTRICIANS	29.78
3%+11.01	
CABLE SPLICERS	32.76
3%+11.01	

ELEC0077C 02/01/2002

	Rates
Fringes	
LINE CONSTRUCTION:	
CABLE SPLICERS	35.44
3.875%+7.20	
LINEMEN, POLE SPRAYERS, HEAVY LINE EQUIPMENT MAN	31.96
3.875%+7.20	
LINE EQUIPMENT MEN	27.91
3.875%+5.45	
POWDERMEN, JACKHAMMERMEN	24.72
3.875%+5.45	
GROUNDMEN	23.27
3.875%+5.45	
TREE TRIMMER	22.46
3.875%+5.45	

ELEC0112E 06/01/2002

	Rates
Fringes	
ASOTIN, BENTON, COLUMBIA, FRANKLIN, GARFIELD, KITTITAS, WALLA WALLA, YAKIMA COUNTIES	
ELECTRICIANS	28.75
3%+9.63	
CABLE SPLICERS	30.19
3%+9.63	

ELEC0191C 08/31/2002

	Rates
Fringes	

ISLAND, SAN JUAN, SNOHOMISH, SKAGIT AND WHATCOM COUNTIES

ELECTRICIANS	30.66
3%+9.33	

CABLE SPLICERS	33.72
3%+9.33	

ELEC0191D 12/01/2002

Rates

Fringes

CHELAN, DOUGLAS, GRANT AND OKANOGAN COUNTIES

ELECTRICIANS	26.66
3%+9.28	

CABLE SPLICERS	39.22
3%+9.28	

ELEC0970A 01/01/2003

Rates

Fringes

COWLITZ AND WAHKIAKUM COUNTIES

ELECTRICIANS	28.55
3%+9.25	

CABLE SPLICERS	31.41
3%+9.25	

ENGI0302E 06/01/2002

Rates

Fringes

CHELAN (WEST OF THE 120TH MERIDIAN), CLALLAM, DOUGLAS (WEST OF
THE 120TH MERIDIAN), GRAYS HARBOR, ISLAND, JEFFERSON, KING,
KITSAP, KITTITAS, MASON, OKANOGAN (WEST OF THE 120TH
MERIDIAN),
SAN JUAN, SKAGIT, SNOHOMISH, WHATCOM AND YAKIMA (WEST OF
THE
120TH MERIDIAN) COUNTIES

PROJECTS

CATEGORY A PROJECTS (excludes Category B projects, as show below)

POWER EQUIPMENT OPERATORS:

Zone 1 (0-25 radius miles):

GROUP 1AAA	31.14	8.40
GROUP 1AA	30.64	8.40
GROUP 1A	30.14	8.40
GROUP 1	29.64	8.40
GROUP 2	29.20	8.40
GROUP 3	28.84	8.40
GROUP 4	26.74	8.40

Zone 2 (26-45 radius miles) - Add \$.70 to Zone 1 rates

Zone 3 (Over 45 radius miles) - Add \$1.00 to Zone 1 rates

BASEPOINTS: Bellingham, Mount Vernon, Kent, Port Angeles, Port Townsend, Aberdeen, Shelton, Bremerton, Wenatchee, Yakima, Seattle, Everett

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons or 300 ft. of boom (including job with attachments)

GROUP 1AA - Cranes - 200 tons to 300 tons or 250 ft. of boom (including jib and attachments); Tower crane over 175 ft. in height, base to boom

GROUP 1A - Cranes - 100 tons thru 199 tons or 150' of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft. in height base to boom; Loader-overhead, 8 yards and over; Shovel, excavator, backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes-45 tons thru 99 tons, under 150 ft. of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Shovel, excavator, backhoes over 3

yards and under 6 yards; Hard tail end dump articulating off-road equipment 45 yards and over; Loader-overhead, 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, d-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self-propelled-45 yards and over; Slipform pavers; Transporters, all track or truck type

GROUP 2 - Barrier machine (zipper); Barch Plant operator-concrete; Bump cutter; Cranes-20 tons thru 44 tons with attachments; Cranes-overheads, bridge type-20 tons through 44 tons; Chipper; Concrete pump-truck mount with boom attachment; Crusher; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel backhoe-3 yards and under; Finishing machine Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders, overhead under 6 yds.; Loaders-plant feed; Locomotives-all; Mechanics-all; Mixers-asphalt plant; Motor patrol graders-finishing; Pildriver (other than crane mount); Roto-mill, roto-grinder; Screedman, Spreader, Topside Operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self-propelled, hard tail end dump, articulating off-road equipment-under 45 yards; Subgrader trimmer; Tractors, backhoes-over 75 hp; Transfer material machine-shuttle buggy, blow knox, roadtec; Truck crane oiler/driver-100 tons and over; Truck mount portable conveyor;Yo Yo Pay Dozer

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; Cranes-A-frame over 10 tons; Drill oilers-auger type, truck or

crane mount; Dozers D9 and under; Forklifts-3000 lbs and over
with attachments; horizontal/directional drill locator;
Outside
hoists-(elevators and manlifts), air tuggers, strao tower
bucket
elevators; Hydralifts/boom truck-over 10 tons; Loader-
elevating
type belt; Motor Patrol Grader-non-finishing; Plant Oiler-
asphalt, crusher; Pumps-concrete; Roller, plant mix or
multi-lift
materials; Saws-concrete; Scrapers-concrete and carryall;
Service
engineers-equipment; Trenching machines; Truck crane oiler/
driver-under 100 tons Tractors, backhoes-under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor;
Concrete Finish Machine-laser screed; Cranes-A-frame-10
tons and
under; Elevator and manlift-permanent and shaft type;
Forklifts-under 3000 lbs. with attachments; Gradechecker,
stakehop; Hydralifts, boom trucks-10 tons and under; Oil
distributors, blower distribution and mulch seeding
operator; Pavement breaker; Post Hole Digger-mechanical;
Power

Plant; Pumps-water; Rigger and Bellman; Roller-other than
plant
mix; Wheel Tractors, farmall type; Shot crete/gunite
equipment
operator

CATEGORY B PROJECTS - 95% of the basic hourly rate for
each
group plus full fringe benefits applicable to Category A
projects
shall apply to the following projects. Reduced rates may
be paid
on the following:

1. Projects involving work on structures such as
buildings
and structures whose total value is less than \$1.5 million
excluding mechanical, electrical, and utility portions of
the
contract.

2. Projects of less than \$1 million where no building is
involved. Surfacing and paving included, but utilities
excluded.

3. Marine projects (docks, wharfs, etc.) less than \$150,000.

WORK PERFORMED ON HYDRAULIC DREDGES:

Total Project Cost \$300,000 and over

GROUP 1	28.38	8.40
GROUP 2	28.48	8.40
GROUP 3	28.82	8.40
GROUP 4	28.87	8.40
GROUP 5	30.26	8.40
GROUP 6	28.38	8.40

GROUP 1: Assistant Mate (Deckhand)

GROUP 2: Oiler

GROUP 3: Assistant Engineer (Electric, Diesel, Steam or Booster Pump); Mates and Boatmen

GROUP 4: Craneman, Engineer Welder

GROUP 5: Leverman, Hydraulic

GROUP 6: Maintenance

Total Project cost under \$300,000

GROUP 1	26.96	8.40
GROUP 2	27.06	8.40
GROUP 3	27.38	8.40
GROUP 4	27.43	8.40
GROUP 5	28.75	8.40
GROUP 6	26.96	8.40

GROUP 1: Assistant Mate (Deckhand)

GROUP 2: Oiler

GROUP 3: Assistant Engineer (Electric, Diesel, Steam, or Booster Pump); Mates and Boatmen

GROUP 4: Craneman, Engineer Welder

GROUP 5: Leverman, Hydraulic

GROUP 6: Maintenance

HEAVY WAGE RATES (CATEGORY A) APPLIES TO CLAM SHELL DREDGE, HOE

AND DIPPER, SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS.

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft

classifications subject to working inside a federally designated

hazardous perimeter shall be eligible for compensation in

accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not

outfitted with protective clothing

H-2 Class "C" Suit - Base wage rate plus \$.25 per hour.

H-3 Class "B" Suit - Base wage rate plus \$.50 per hour.

H-4 Class "A" Suit - Base wage rate plus \$.75 per hour.

ENGI0370C 06/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, CHELAN (EAST OF THE 120TH MERIDIAN), COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN (EAST OF THE 120TH MERIDIAN), PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND YAKIMA (EAST OF THE 120TH MERIDIAN) COUNTIES

ZONE 1:

POWER EQUIPMENT OPERATORS:

GROUP 1A	20.94	6.52
GROUP 1	21.49	6.52
GROUP 2	21.81	6.52
GROUP 3	22.42	6.52
GROUP 4	22.58	6.52
GROUP 5	22.74	6.52
GROUP 6	23.02	6.52
GROUP 7	23.29	6.52
GROUP 8	24.39	6.52

ZONE DIFFERENTIAL (Add to Zone 1 rate): Zone 2 - \$2.00

Zone 1: Within 45 mile radius of Spokane, Moses Lake, Pasco,

Washington; Lewiston, Idaho

Zone 2: Outside 45 mile radius of Spokane, Moses Lake, Pasco,

Washington; Lewiston, Idaho

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1A: Boat Operator; Crush Feeder; Oiler; Steam Cleaner

GROUP 1: Bit Grinders; Bolt Threading Machine; Compressors (under 2000 CFM, gas, diesel, or electric power); Deck Hand; Drillers Helper (Assist driller in making drill rod connections, service drill engine and air compressor, repair drill rig and drill tools, drive drill support truck to and on the job site, remove drill cuttings from around bore hole and inspect drill rig while in operation); Fireman & Heater Tender; Grade Checker; Hydro-seeder, Mulcher, Nozzleman; Oiler Driver, & Cable Tender, Mucking Machine; Pumpman; Rollers, all types on subgrade, including seal and chip coatings (farm type, Case, John Deere & similar, or Compacting Vibrator), except when pulled by Dozer with operable blade; Welding Machine

GROUP 2: A-frame Truck (single drum); Assistant Refrigeration Plant (under 1000 ton); Assistant Plant Operator, Fireman or Pugmixer (asphalt); Bagley or Stationary Scraper; Belt Finishing Machine; Blower Operator (cement); Cement Hog; Compressor (2000 CFM or over, 2 or more, gas diesel or electric power); Concrete Saw (multiple cut); Distributor Leverman; Ditch Witch or similar; Elevator Hoisting Materials; Dope Pots (power agitated); Fork Lift or Lumber Stacker, hydra-lift & similar; Gin Trucks (pipeline); Hoist, single drum; Loaders (bucket elevators and conveyors); Longitudinal Float; Mixer (portable-concrete);

Pavement Breaker, Hydra-Hammer & similar; Power Broom;
Railroad
Ballast Regulation Operator (self-propelled); Railroad
Power
Tamper Operator (self-propelled); Railroad Tamper Jack
Operator (self-propelled); Spray Curing Machine (concrete);
Spreader Box (self-propelled); Straddle Buggy (Ross &
similar
on construction job only); Tractor (Farm type R/T with
attachment, except Backhoe); Tugger Operator

GROUP 3: A-frame Truck (2 or more drums); Assistant
Refrigeration Plant & Chiller Operator (over 1000 ton);
Backfillers (Cleveland & similar); Batch Plant & Wet Mix
Operator, single unit (concrete); Belt-Crete Conveyors with
power pack or similar; Belt Loader (Kocal or similar);
Bending
Machine; Bob Cat; Boring Machine (earth); Boring Machine
(rock
under 8" bit) (Quarry Master, Joy or similar); Bump Cutter
(Wayne, Saginaw or similar); Canal Lining Machine
(concrete);
Chipper (without crane); Cleaning & Doping Machine
(pipeline);
Deck Engineer; Elevating Belt-type Loader (Euclid, Barber
Green &
similar); Elevating Grader-type Loader (Dumora, Adams or
similar);
Generator Plant Engineers (diesel or electric); Gunnite
Combination Mixer & Compressor; Locomotive Engineer;
Mixermobile;
Mucking Machine; Posthole Auger or Punch; Pump (grout or
jet);
Soil Stabilizer (P & H or similar); Spreader Machine;
Tractor (to
D-6 or equivalent) and Traxcavator; Traverse Finish
Machine;
Turnhead Operator

GROUP 4: Concrete Pumps (squeeze-crete, flow-crete, pump-
crete, Whitman & similar); Curb Extruder (asphalt or
concrete); Drills (churn, core, calyx or diamond)(operate
drilling machine, drive or transport drill rig to and on
job site
and weld well casing); Equipment Serviceman; Greaser &
Oiler;
Hoist (2 or more drums or Tower Hoist); Loaders (overhead &

front-end, under 4 yds. R/T); Refrigeration Plant Engineer (under 1000 ton); Rubber-tired Skidders (R/T with or without attachments); Surface Heater & Plant Machine; Trenching Machines (under 7 ft. depth capacity); Turnhead (with re-screening); Vacuum Drill (reverse circulation drill under 8" bit)

GROUP 5: Backhoe (under 45,000 gw); Backhoe & Hoe Ram (under 3/4 yd.); Carrydeck & Boom Truck (under 25 tons); Cranes (25 tons & under), all attachments including clamshell, dragline; Derricks & Stifflegs (under 65 tons); Drilling Equipment(8" bit & over) (Robbins, reverse circulation & similar)(operates drilling machine, drive or transport drill rig to and on job site and weld well casing); Hoe Ram; Piledriving Engineers; Paving (dual drum); Railroad Track Liner Operatr (self-propelled);

Refrigeration Plant Engineer (1000 tons & over); Signalman (Whirleys, Highline Hammerheads or similar)

GROUP 6: Asphalt Plant Operator; Automatic Subgrader (Ditches & Trimmers)(Autograde, ABC, R.A. Hansen & similar on grade wire); Backhoe (45,000 gw and over to 110,000 gw); Backhoes & Hoe Ram (3/4 yd. to 3 yd.); Batch Plant (over 4 units); Batch & Wet Mix Operator (multiple units, 2 & incl. 4); Blade Operator (motor patrol & attachments, Athey & Huber); Boom Cats (side); Cable Controller (dispatcher); Clamshell Operator (under 3 yds.); Compactor (self-propelled with blade); Concrete Pump Boom Truck; Concrete Slip Form Paver; Cranes (over 25 tons, to and including 45 tons), all attachments including clamshell, dragline; Crusher, Grizzle & Screening Plant Operator; Dozer, 834 R/T & similar; Draglines (under 3 yds.); Drill Doctor; H.D. Mechanic; H.D. Welder; Loader Operator (front-end &

overhead, 4 yds. incl. 8 yds.); Multiple Dozer Units with single blade; Paving Machine (asphalt and concrete); Quad-Track or similar equipment; Rollerman (finishing asphalt pavement); Roto Mill (pavement grinder); Scrapers, all, rubber-tired; Screed Operator; Shovel (under 3 yds.); Tractors (D-6 & equivalent & over); Trenching Machines (7 ft. depth & over); Tug Boat Operator
Vactor guzzler, super sucker

GROUP 7: Backhoe (over 110,000 gw); Backhoes & Hoe Ram (3 yds & over); Blade (finish & bluetop) Automatic, CMI, ABC, Finish Athey & Huber & similar when used as automatic; Cableway Operators; Concrete Cleaning/Decontamination machine operator; Cranes (over 45 tons to but not including 85 tons), all attachments including clamshell and dragline; Derricks & Stiffleys (65 tons & over); Elevating Belt (Holland type); Heavy equipment robotics operator; Loader (360 degrees revolving Koehring Scooper or similar); Loaders (overhead & front-end, over 8 yds. to 10 yds.); Rubber-tired Scrapers (multiple engine with three or more scrapers); Shovels (3 yds. & over); Whirleys & Hammerheads, ALL

GROUP 8: Cranes (85 tons and over, and all climbing, overhead, rail and tower), all attachments including clamshell, dragline; Loaders (overhead and front-end, 10 yards and over); Helicopter Pilot

BOOM PAY: (All Cranes, Including Tower)
180' to 250' \$.30 over scale
Over 250' \$.60 over scale

NOTE: In computing the length of the boom on Tower Cranes, they shall be measured from the base of the Tower to the point

of the boom.

HAZMAT: Anyone working on HAZMAT jobs, working with
supplied air
shall receive \$1.00 an hour above classification.

ENGI0370G 06/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, CHELAN (EAST OF THE 120TH MERIDIAN),

COLUMBIA, DOUGLAS (EAST OF THE 120TH MERIDIAN), FERRY,
FRANKLIN,
GARFIELD, GRANT, LINCOLN, OKANOGAN (EAST OF THE 120TH
MERIDIAN),
PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN AND
YAKIMA
(EAST OF THE 120TH MERIDIAN) COUNTIES

WORK PERFORMED ON HYDRAULIC DREDGES

GROUP 1:	24.73	6.27
GROUP 2:	25.10	6.27
GROUP 3:	25.13	6.27
GROUP 4:	25.52	6.27
GROUP 5:	24.73	6.27

GROUP 1: Assistant Mate (Deckhand) and Oiler
GROUP 2: Assistant Engineer (Electric, Diesel, Steam, or
Booster Pump); Mates and Boatmen
GROUP 3: Engineer Welder
GROUP 4: Leverman, Hydraulic
GROUP 5: Maintenance

HEAVY WAGE RATES APPLIES TO CLAM SHELL DREDGE, HOE AND
DIPPER,
SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS.

ENGI0612A 06/01/2002

Rates

Fringes

LEWIS, PIERCE, PACIFIC (THAT PORTION WHICH LIES NORTH OF A
PARALLEL LINE EXTENDED WEST FROM THE NORTHERN BOUNDARY OF
WAHKAIKUM COUNTY TO THE SEA IN THE STATE OF WASHINGTON) AND

THURSTON COUNTIES

PROJECTS:

CATEGORY A PROJECTS (excludes Category B projects, as shown below)

POWER EQUIPMENT OPERATORS:

ZONE 1 (0-25 radius miles):

GROUP 1AAA	31.14
8.40	
GROUP 1AA	30.64
8.40	
GROUP 1A	30.14
8.40	
GROUP 1	29.64
8.40	
GROUP 2	29.20
8.40	
GROUP 3	28.94
8.40	
GROUP 4	26.74
8.40	

ZONE 2 (26-45 radius miles) - Add \$.70 to Zone 1 rates

ZONE 3 (Over 45 radius miles) - Add \$1.00 to Zone 1 rates

BASEPOINTS: Tacoma, Olympia, and Centralia

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-300 tons, or 300 ft of boom (including jib with attachments)

GROUP 1AA - Cranes 200 tons to 300 tons, or 250 ft of boom (including jib with attachments); Tower crane over 175 ft in

height, base to boom

GROUP 1A - Crane 100 tons thru 199 tons, or 150 of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Shovel, excavator, backhoes-6 yds and over with attachments

GROUP 1 - Cableways; Cranes-45 tons thru 99 tons, under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type - 45 tons thru 99 tons; Excavator, shovel, backhoes over 3 yards and under 6 yards; hard tail end dump articulating off-road equipment 45 yards and over; loader-overhead 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, D-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self-propelled-45 yds and over; Slipform pavers; Transporters-all track or truck type

GROUP 2 - Barrier machine (zipper); Batch Plant Operator-concrete; Bump cutter; Cranes-20 tons through 44 tons with attachments; Crane-overhead, bridge type-20 tons thru 44 tons; Chipper, Concrete Pump-truck mounted with boom attachment; Crushers; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel, backhoe-3yards and under; Finishing machine, Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders, overhead under 6 yds.; Loaders, plant feed; Locomotive-all; Mechanics-all; Mixers, asphalt plant; Motor patrol graders-finishing; Piledriver (other than crane mount); Roto-mill, roto grinder; screedman, spreader, topside operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self propelled, hard tail end dump, articulating off-road equipment under 45 yds.; Subgrader trimmer; Tractors, backhoes over 75 hp.; Transfer material service machine-shuttle buggy, Blaw Knox-Roadtec; Truck Crane Oiler/driver-100 tons and over, Truck Mount Portable Conveyor; Yo Yo Pay dozer.

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; Cranes-A-frame over 10 tons; Drill Oilers-Auger type, truck or crane mount; Dozers-D-9 and under; Forklifts-3000 lbs. and over with attachments; Horizontal/directional drill locator; Outside hoists-(elevators and manlifts), air tuggers, strato tower bucket elevators; Hydralifts/Boom Trucks-over 10 tons; Loaders-elevating type, belt; Motor patrol grader-nonfinishing; Plant Oiler-Asphalt, Crusher; Pumps, Concrete; Roller, plant mix or multi-lift materials; Saws-concrete; Scrapers-Concrete and Carry all; Trenching machines; Truck Crane Oiler/Driver-under 100 tons; Tractor, backhoe-under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete Finish Machine-laser screed; Crane-A-Frame, 10 tons and under; Elevator and manlift-permanent and shaft type; Forklifts-under 3000 lbs. with attachments; Gradechecker, stakeop; Hydralifts, boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Posthole Digger-mechanical; Power plant; Pumps-Water; Roller-other than Plant Mix; Wheel Tractors, Farmall type; Shotcrete/Gunite Equipment Operator

CATEGORY B PROJECTS - 95% of the basic hourly rate for each group plus full fringe benefits applicable to Category A projects shall apply to the following projects: Reduced rates may be paid on the following:

1. Projects involving work on structures such as buildings and structures whose total value is less than \$1.5 million excluding mechanical, electrical, and utility portions of the contract.

2. Projects of less than \$1 million where no building is

involved. Surfacing and paving included, but utilities excluded.

3. Marine projects (docks, wharfs, etc.) less than \$150,000

WORK PERFORMED ON HYDRAULIC DREDGES:

Total Project cost \$300,000 and over

GROUP 1	28.38	8.40
GROUP 2	28.48	8.40
GROUP 3	28.82	8.40
GROUP 4	28.87	8.40
GROUP 5	30.26	8.40
GROUP 6	28.38	8.40

GROUP 1: Assistant Mate (Deckhand)

GROUP 2: Oiler

GROUP 3: Assistant Engineer (Electric, Diesel, Steam or Booster Pump); Mates and Boatmen

GROUP 4: Craneman, Engineer Welder

GROUP 5: Leverman, Hydraulic

GROUP 6: Maintenance

Total Project Cost under \$300,000

GROUP 1	26.96	8.40
GROUP 2	27.06	8.40
GROUP 3	27.38	8.40
GROUP 4	27.43	8.40
GROUP 5	28.75	8.40
GROUP 6	26.96	8.40

GROUP 1: Assistant Mate (Deckhand)

GROUP 2: Oiler

GROUP 3: Assistant Engineer (Electric, Diesel, Steam or Booster Pump); Mates and Boatmen

GROUP 4: Craneman, Engineer Welder

GROUP 5: Leverman, Hydraulic

GROUP 6: Maintenance

HEAVY WAGE RATES APPLIES TO CLAM SHEEL DREDGE, HOE AND DIPPER, SHOVELS AND SHOVEL ATTACHMENTS, CRANES AND BULLDOZERS

HANDLING OF HAZARDOUS WASTE MATERIALS

H-1 - When not outfitted with protective clothing of level D equipment - Base wage rate

H-2 - Class "C" Suit - Base wage rate + \$.25 per hour

H-3 - Class "B" Suit - Base wage rate + \$.50 per hour
H-4 - Class "A" Suit - Base wage rate +\$.75 per hour

ENGI0701D 01/01/2003

Rates

Fringes

CLARK, COWLITZ, KICKKITAT, PACIFIC (SOUTH), SKAMANIA, AND
WAHIAKUM COUNTIES

POWER EQUIPMENT OPERATORS (See Footnote A)

ZONE 1:

GROUP 1	29.30	8.95
GROUP 1A	30.77	8.95
GROUP 1B	32.23	8.95
GROUP 2	28.07	8.95
GROUP 3	27.31	8.95
GROUP 4	26.79	8.95
GROUP 5	26.19	8.95
GROUP 6	23.84	8.95

Zone Differential (add to Zone 1 rates):

Zone 2 - \$1.50
Zone 3 - 3.00

For the following metropolitan counties: MULTNOMAH;
CLACKAMAS;
MARION; WASHINGTON; YAMHILL; AND COLUMBIA; CLARK; AND
COWLITZ
COUNTY, WASHINGTON WITH MODIFICATIONS AS INDICATED:

All jobs or projects located in Multnomah, Clackamas and
Marion
Counties, West of the western boundary of Mt. Hood National
Forest and West of Mile Post 30 on Interstate 84 and West
of Mile
Post 30 on State Highway 26 and West of Mile Post 30 on
Highway
22 and all jobs or projects located in Yamhill County,
Washington
County and Columbia County and all jobs or projects located
in
Clark & Cowlitz County, Washington except that portion of
Cowlitz
County in the Mt. St. Helens "Blast Zone" shall receive
Zone I
pay for all classifications.

All jobs or projects located in the area outside the identified boundary above, but less than 50 miles from the Portland City Hall shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the Portland City Hall, but outside the identified border above, shall receive Zone III pay for all classifications.

For the following cities: ALBANY; BEND; COOS BAY; EUGENE; GRANTS PASS; KLAMATH FALLS; MEDFORD; ROSEBURG

All jobs or projects located within 30 miles of the respective city hall of the above mentioned cities shall receive Zone I pay for all classifications.

All jobs or projects located more than 30 miles and less than 50 miles from the respective city hall of the above mentioned cities shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the respective city hall of the above mentioned cities shall receive Zone III pay for all classifications.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: CONCRETE: Batch Plant and/or Wet Mix Operator, three units or more; CRANE: Helicopter Operator, when used in erecting work; Whirley Operator, 90 ton and over; LATTICE BOOM CRANE: Operator 200 tons through 299 tons, and/or over 200 feet boom; HYDRAULIC CRANE: Hydraulic Crane Operator 90 tons through 199 tons with luffing or tower attachments; FLOATING EQUIPMENT:

Floating Crane, 150 ton but less than 250 ton

GROUP 1A: HYDRAULIC CRANE: Hydraulic Operator, 200 tons and over

(with luffing or tower attachment); LATTICE BOOM CRANE: Operator,

200 tons through 299 tons, with over 200 feet boom;

FLOATING

EQUIPMENT: Floating Crane 250 ton and over

GROUP 1B: LATTICE BOOM CRANE: Operator, 300 tons through 399 tons

with over 200 feet boom; Operator 400 tons and over;

FLOATING

EQUIPMENT: Floating Crane 350 ton and over

GROUP 2: ASPHALT: Asphalt Plant Operator (any type); Roto Mill,

pavement profiler, operator, 6 foot lateral cut and over;

BLADE: Auto Grader or "Trimmer" (Grade Checker required);

Blade Operator, Robotic; BULLDOZERS: Bulldozer operator over

120,000 lbs and above; Bulldozer operator, twin engine;

Bulldozer Operator, tandem, quadnine, D10, D11, and similar type;

Bulldozere Robotic Equipment (any type; CONCRETE: Batch Plant

and/or Wet Mix Operator, one and two drum; Automatic Concrete

Slip Form Paver Operator; Concrete Canal Line Operator;

Concrete Profiler, Diamond Head; CRANE: Cableway Operator, 25

tons and over; HYDRAULIC CRANE: Hydraulic crane operator 90 tons

through 199 tons (with luffing or tower attachment);

TOWER/WHIRLEY OPERATOR: Tower Crane Operator;

Whirley Operator, under 90 tons; LATTICE BOOM CRANE: 90 through

199 tons and/or 150 to 200 feet boom; CRUSHER: Crusher

Plant Operator; FLOATING EQUIPMENT: Floating Clamshell,

etc. operator, 3 cu. yds. and over; Floating Crane (derrick barge)

Operator, 30 tons but less than 150 tons; LOADERS: Loader

operator, 120,000 lbs. and above; REMOTE CONTROL: Remote

controlled earth-moving equipment; RUBBER-TIRED SCRAPERS: Rubber-

tired scraper operator, with tandem scrapers, multi-engine;

SHOVEL, DRAGLINE, CLAMSHELL, SKOOPER OPERATOR: Shovel, Dragline, Clamshell, operator 5 cu. yds and over; TRENCHING MACHINE: Wheel Excavator, under 750 cu. yds. per hour (Grade Oiler required); Canal Trimmer (Grade Oiler required); Wheel Excavator, over 750 cu. yds. per hour; Band Wagon (in conjunction with wheel excavator); UNDERWATER EQUIPMENT: Underwater Equipment Operator, remote or otherwise; HYDRAULIC HOES-EXCAVATOR: Excavator over 130,000 lbs.

GROUP 3: BULLDOZERS: Bulldozer operator, over 70,000 lbs. up to

and including 120,000 lbs.; HYDRAULIC CRANE: Hydraulic crane operator, 50 tons through 89 tons (with luffing or tower attachment); LATTICE BOOM CRANES: Lattice Boom Crane-50 through 89 tons (and less than 150 feet boom); FORKLIFT: Rock Hound Operator; HYDRAULIC HOES-EXCAVATOR: excavator over 80,000 lbs. through 130,000 lbs.; LOADERS: Loader operator 60,000 and less than 120,000; RUBBER-TIRED SCRAPERS: Scraper Operator, with tandem scrapers; Self-loading, paddle wheel, auger type, finish and/or 2 or more units; SHOVEL, DRAGLINE, CLAMSHELL,SKOOPER OPERATOR: Shovel, Dragline, Clamshell operators 3 cu. yds. but less than 5 cu yds.

GROUP 4: ASPHALT: Screed Operator; Asphalt Paver operator (screeman required); BLADE: Blade operator; Blade operator, finish; Blade operator, externally controlled by electronic, mechanical hydraulic means; Blade operator, multi-engine; BULLDOZERS: Bulldozer Operator over 20,000 lbs and more than 100 horse up to 70,000 lbs; Drill Cat Operator; Side-boom Operator; Cable-Plow Operator (any type); CLEARING: Log Skidders; Chippers; Incinerator; Stump Splitter (loader mounted or similar type); Stump Grinder (loader mounted or similar type; Tub

Grinder; Land Clearing Machine (Track mounted forestry mowing & grinding machine); Hydro Axe (loader mounted or similar type);
COMPACTORS SELF-PROPELLED: Compactor Operator, with blade; Compactor Operator, multi-engine; Compactor Operator, robotic;
CONCRETE: Mixer Mobile Operator; Screed Operator; Concrete Cooling Machine Operator; Concrete Paving Road Mixer; Concrete Breaker; Reinforced Tank Banding Machine (K-17 or similar types);
Laser Screed; CRANE: Chicago boom and similar types; Lift Slab Machine Operator; Boom type lifting device, 5 ton capacity or less; Hoist Operator, two (2) drum; Hoist Operator, three (3) or more drums; Derrick Operator, under 100 ton; Hoist Operator, stiff leg, guy derrick or similar type, 50 ton and over; Cableway Operator up to twenty (25) ton; Bridge Crane Operator, Locomotive, Gantry, Overhead; Cherry Picker or similar type crane; Carry Deck Operator; Hydraulic Crane Operator, under 50 tons; LATTICE BOOM CRANE OPERATOR: Lattice Boom Crane Operator, under 50 tons; CRUSHER: Generator Operator; Diesel-Electric Engineer; Grizzley Operator; Drill Doctor; Boring Machine Operator; Driller-Percussion, Diamond, Core, Cable, Rotary and similar type; Cat Drill (John Henry); Directional Drill Operator over 20,000 lbs pullback; FLOATING EQUIPMENT: Diesel-electric Engineer; Jack Operator, elevating barges, Barge Operator, self-unloading; Piledriver Operator (not crane type) (Deckhand required); Floating Clamshell, etc. Operator, under 3 cu. yds. (Fireman or Diesel-Electric Engineer required); Floating Crane (derrick barge) Operator, less than 30 tons; GENERATORS: Generator Operator; Diesel-electric Engineer; GUARDRAIL EQUIPMENT: Guardrail Punch Operator (all types); Guardrail Auger

Operator (all types); Combination Guardrail machines, i.e., punch
 auger, etc.; HEATING PLANT: Surface Heater and Planer
 Operator;
 HYDRAULIC HOES EXCAVATOR: Robotic Hydraulic backhoe
 operator,
 track and wheel type up to and including 20,000 lbs. with
 any or
 all attachments; Excavator Operator over 20,000 lbs through
 80,000 lbs.; LOADERS: Belt Loaders, Kolman and Ko Cal
 types;
 Loaders Operator, front end and overhead, 25,000 lbs and
 less

 than 60,000 lbs; Elevating Grader Operator by Tractor
 operator,
 Sierra, Euclid or similar types; PILEDRIVERS: Hammer
 Operator;
 Piledriver Operator (not crane type); PIPELINE, SEWER
 WATER: Pipe
 Cleaning Machine Operator; Pipe Doping Machine Operator;
 Pipe
 Bending Machine Operator; Pipe Wrapping Machine Operator;
 Boring
 Machine Operator; Back Filling Machine Operator; REMOTE
 CONTROL:
 Concrete Cleaning Decontamination Machine Operator; Ultra
 High
 Pressure Water Jet Cutting Tool System Operator/Mechanic;
 Vacuum
 Blasting Machine Operator/mechanic; REPAIRMEN, HEAVY DUTY:
 Diesel
 Electric Engineer (Plant or Floating; Bolt Threading
 Machine
 operator; Drill Doctor (Bit Grinder); H.D. Mechanic;
 Machine Tool
 Operator; RUBBER-TIRED SCRAPERS: Rubber-tired Scraper
 Operator, single engine, single scraper; Self-loading,
 paddle
 wheel, auger type under 15 cu. yds.; Rubber-tired Scraper
 Operator, twin engine; Rubber-tired Scraper Operator, with
 push-
 ull attachments; Self Loading, paddle wheel, auger type 15
 cu.
 yds. and over, single engine; Water pulls, water wagons;
 SHOVEL,
 DRAGLINE, CLAMSHELL, SKOOPER OPERATOR: Diesel Electric
 Engineer;

Stationary Drag Scraper Operator; Shovel, Dragline, Clamshell, Operator under 3 cu yds.; Grade-all Operator; SURFACE (BASE) MATERIAL: Blade mounted spreaders, Ulrich and similar types; TRACTOR-RUBBERED TIRED: Tractor operator, rubber-tired, over 50 hp flywheel; Tractor operator, with boom attachment; Rubber-tired dozers and pushers (Michigan, Cat, Hough type); Skip Loader, Drag Box; TRENCHING MACHINE: Trenching Machine operator, digging capacity over 3 ft depth; Back filling machine operator; TUNNEL: Mucking machine operator

GROUP 5: ASPHALT: Extrusion Machine Operator; Roller Operator (any asphalt mix); Asphalt Burner and Reconditioner Operator (any type); Roto-Mill, pavement profiler, ground man; BULLDOZERS: Bulldozer operator, 20,000 lbs. or less or 100 horse or less; COMPRESSORS: Compressor Operator (any power), over 1,250 cu. ft. total capacity; COMPACTORS: Compactor Operator, including vibratory; Wagner Pactor Operator or similar type (without blade); CONCRETE: Combination mixer and Compressor Operator, gunite work; Concrete Batch Plant Quality Control Operator; Belcrete Operator; Pumpcrete Operator (any type); Pavement Grinder and/or Grooving Machine Operator (riding type); Cement Pump Operator, Fuller-Kenyon and similar; Concrete Pump Operator; Grouting Machine Operator; Concrete mixer operator, single drum, under (5) bag capacity; Cast in place pipe laying machine; maginnis Internal Full slab vibrator operator; Concrete finishing machine operator, Clary, Johnson, Bidwell, Burgess Bridge deck or similar type; Curb Machine Operator, mechanical Berm, Curb and/or Curb and Gutter; Concrete Joint Machine Operator; Concrete Planer Operator; Tower Mobile Operator; Power

Jumbo Operator setting slip forms in tunnels; Slip Form Pumps, power driven hydraulic lifting device for concrete forms; Concrete Paving Machine Operator; Concrete Finishing Machine Operator; Concrete Spreader Operator; CRANE: Helicopter Hoist Operator; Hoist Operator, single drum; Elevator Operator; A-frame Truck Operator, Double drum; Boom Truck Operator; HYDRAULIC CRANE OPERATOR: Hydraulic Boom Truck, Pittman; DRILLING: Churn Drill and Earth Boring Machine Operator; Vacuum Truck; Directional Drill Operator over 20,000 lbs pullback; FLOATING EQUIPMENT:

Fireman; FORKLIFT: Fork Lift, over 10 ton and/or robotic; HYDRAULIC HOES EXCAVATORS: Hydraulic Backhoe Operator, wheel type (Ford, John Deere, Case type); Hydraulic Backhoe Operator track type up to and including 20,000 lbs.; LOADERS: Loaders, rubber-tired type, less than 25,000 lbs; Elevating Grader Operator, Tractor Towed requiring Operator or Grader; Elevating loader operator, Athey and similar types; OILERS: Service oiler (Greaser); PIPELINE-SEWER WATER: Hydra hammer or simialr types; Pavement Breaker Operator; PUMPS: Pump Operator, more than 5 (any size); Pot Rammer Operator; RAILROAD EQUIPMENT: Locomotive Operator, under 40 tons; Ballast Regulator Operator; Ballast Tamper Multi-Purpose Operator; Track Liner Operator; Tie Spacer Operator; Shuttle Car Operator; Locomotive Operator, 40 tons and over; MATERIAL HAULRS: Cat wagon DJB's Volvo similar types; Conveyored material hauler; SURFACING (BASE) MATERIAL: Rock Spreaders, self-propelled; Pulva-mixer or similar types; Chiip Spreading machine operator; Lime spreading operator, construction

job siter; SWEEPERS: Sweeper operator (Wayne type) self-propelled
 construction job site; TRACTOR-RUBBER TIRED: Tractor operator,
 rubber-tired, 50 hp flywheel and under; Trenching machine operator,
 maximum digging capacity 3 ft depth; TUNNEL: Dinkey
 GROUP 6: ASPHALT: Plant Oiler; Plant Fireman; Pugmill Operator (any type);
 Truck mounted asphalt spreader, with screed;
 COMPRESSORS: Compressor Operator (any power), under 1,250 cu. ft.
 total capacity; CONCRETE: Plant Oiler, Assistant Conveyor Operator;
 Conveyor Operator; Mixer Box Operator (C.T.B., dry batch, etc.);
 Cement Hog Operator; Concrete Saw Operator; Concrete Curing Machine
 Operator (riding type); Wire Mat or Brooming Machine Operator; CRANE:
 Oiler; Fireman, all equipment;
 Truck Crane Oiler Driver; A-frame Truck Operator, single drum;
 Tugger or Coffin Type Hoist Operator; CRUSHER: Crusher
 Oiler; Crusher Feeder; CRUSHER: Crusher oiler; Crusher feeder;
 DRILLING: Drill Tender; Auger Oiler; FLOATING EQUIPMENT: Deckhand;
 Boatman; FORKLIFT: Self-propelled Scaffolding Operator, construction
 job site (excluding working platform); Fork Lift or Lumber Stacker
 Operator, construction job site; Ross Carrier Operator, construction
 job site; Lull Hi-Lift Operator or Similar Type; GUARDRAIL EQUIPMENT:
 Oiler; Auger Oiler; Oiler, combination guardrail machines; Guardrail
 Punch Oiler; HEATING PLANT: Temporary Heating Plant Operator;
 LOADERS: Bobcat, skid steer (less than 1 cu yd.); Bucket Elevator
 Loader Operator, BarberGreene and similar types; OILERS: Oiler;
 Guardrail Punch Oiler; Truck Crane Oiler-Driver; Auger Oiler;
 Grade Oiler, required to check grade; Grade Checker; Rigger;
 PIPELINE-SEWER WATER: Tar Pot Fireman; Tar Pot Fireman (power
 agitated); PUMPS: Pump Operator (any power); Hydrostatic Pump
 Operator; RAILROAD EQUIPMENT: Brakeman; Oiler; Switchman;

Motorman; Ballast Jack Tamper Operator; SHOVEL, DRAGLINE, CLAMSHELL, SKOOPER, ETC. OPERATOR: Oiler, Grade Oiler (required to check grade); Grade Checker; Fireman; SWEEPER: Broom operator, self propelled, construction job site; SURFACING (BASE) MATERIAL: Roller Operator, grading of base rock (not asphalt); Tamping Machine operator, mechanical, self-propelled; Hydrographic Seeder Machine Operator; TRENCHING MACHINE: Oiler; Grade Oiler; TUNNEL: Conveyor operator; Air filtration equipment operator

ENGI0701E 06/01/2002

Rates

Fringes

CLARK, COWLITZ, KLUCKITAT, PACIFIC (SOUTH), SKAMANIA, AND WAHIAKUM COUNTIES

DREDGING:

ZONE A		
LEVERMAN, HYDRAULIC	32.43	8.50
LEVERMAN, DIPPER, FLOATING CLAMSHELL	30.25	8.50
ASSISTANT ENGINEER	29.25	8.50
TENDERMAN	28.44	8.50
ASSISTANT MATE	26.58	8.50

ZONE B		
LEVERMAN, HYDRAULIC	34.43	8.50
LEVERMAN, DIPPER, FLOATING CLAMSHELL	32.25	8.50
ASSISTANT ENGINEER	31.25	8.50
TENDERMAN	30.44	8.50
ASSISTANT MATE	28.58	8.50

ZONE C		
LEVERMAN, HYDRAULIC	35.43	8.50
LEVERMAN, DIPPER, FLOATING CLAMSHELL	33.25	8.50
ASSISTANT ENGINEER	32.25	8.50
TENDERMAN	31.44	8.50

ASSISTANT MATE	29.58	8.50
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ZONE DESCRIPTION FOR DREDGING:

ZONE A - All jobs or projects located within 30 road miles of

Portland City Hall.

ZONE B - Over 30-50 road miles from Portland City Hall.

ZONE C - Over 50 road miles from Portland City Hall.

*All jobs or projects shall be computed from the city hall by the shortest route to the geographical center of the project.

IRON0014F 07/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN, OKANOGAN, PEND ORIELLE, SPOKANE, STEVENS, WALLA WALLA AND WHITMAN COUNTIES

IRONWORKERS	24.52	11.80
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IRON0029I 07/01/2002

Rates

Fringes

CLARK, COWLITZ, KLINKITAT, PACIFIC, SKAMANIA, AND WAHKAIAKUM COUNTIES

IRONWORKERS	26.97	11.80
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IRON0086B 07/01/2002

Rates

Fringes

YAKIMA, KITTITAS AND CHELAN COUNTIES

IRONWORKERS	26.72	11.80
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* IRON0086E 07/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP,
LEWIS,
MASON, PIERCE, SKAGIT, SNOHOMISH, THURSTON, AND WHATCOM
COUNTIES

IRONWORKERS	27.22	11.80

LAB00001D 06/01/2002

Rates

Fringes
CHELAN, DOUGLAS (WEST OF THE 120TH MERIDIAN), KITTITAS AND
YAKIMA COUNTIES

LABORERS:

ZONE 1:

GROUP 1	14.79	6.20
GROUP 2	17.11	6.20
GROUP 3	18.83	6.20
GROUP 4	19.31	6.20
GROUP 5	19.67	6.20

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$.70

ZONE 3 - \$1.00

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE,
AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective
city

hall

ZONE 2 - More than 25 but less than 45 radius miles from
the

respective city hall

ZONE 3 - More than 45 radius miles from the respective city
hall

CALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP,
LEWIS,
MASON, PACIFIC (NORTH OF STRAIGHT LINE MADE BY EXTENDING
THE
NORTH BOUNDARY WAHKIAKUM COUNTY WEST TO THE PACIFIC OCEAN),
PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND WHATCOM
COUNTIES

LABORERS:

ZONE 1:		
GROUP 1	17.71	6.20
GROUP 2	20.03	6.20
GROUP 3	24.71	6.20
GROUP 4	25.19	6.20
GROUP 5	25.55	6.20

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$.70

ZONE 3 - \$1.00

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT,
SEATTLE, KENT, TACOMA, OLYMPIA,
CENTRALIA, ABERDEEN, SHELTON, PT.
TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective city

hall

ZONE 2 - More than 25 but less than 45 radius miles from the

respective city hall

ZONE 3 - More than 45 radius miles from the respective city hall

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window Washer/Cleaner (detail clean-up, such as but not limited to cleaning floors, ceilings, walls, windows, etc., prior to final acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer; Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating Screed; Asbestos Abatement Laborer; Ballast Regulator Machine; Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender; Cement Finisher Tender; Change House or Dry Shack; Chipping Gun (under 30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer; Concrete Form Stripper; Curing Laborer; Demolition (wrecking and moving

including charred material); Ditch Digger; Dump Person;
Fine
Graders; Firewatch; Form Setter; Gabian Basket Builders;
Grout
Machine Tender; Grinders; Guardrail Erector; Hazardous
Waste
Worker (Level C); Maintenance Person; Material Yard Person;
Pot
Tender; Rip Rap Person; Riggers; Scale Person; Sloper
Sprayer;
Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at
job
site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl
Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30
lbs.);
Clary Power Spreader; Concrete Dumper/Chute Operator;
Concrete
Saw Operator; Drill Operator (hydraulic, diamond,
aiartrac);
Faller and Bucker Chain Saw; Grade Checker and Transit
Person;
Groutmen (pressure) including post tension beams; Hazardous
Waste
Worker (Level B); High Scaler; Jackhammer; Laserbeam
Operator;
Manhole Builder-Mudman; Mortarman and Hodcarrier; Nozzleman
(concrete pump, green cutter when using combination of high
pressure air and water on concrete and rock, sandblast,
gunite,
shotcrete, water blaster, vacuum blaster); Pavement
Breaker; Pipe
Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not
insert
type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-
Power;
Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20');
Spreader

(concrete); Tamper and Similar electric, air and glas
operated
tool; Timber Person-sewer (lagger shorer and cribber);
Track Liner Power; Tugger Operator; Vibrator; Well Point
Laborer

GROUP 5: Caisson Worker; Miner; Powderman; Re-Timberman;
Hazardous Waste Worker (Level A).

LAB00238E 06/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, COLUMBIA, DOUGLAS (EAST OF THE 120TH
MERIDIAN), FERRY, FRANKLIN, GARFIELD, GRANT, LINCOLN,
OKANOGAN, PEND OREILLE, STEVENS, SPOKANE, WALLA WALLA AND
WHITMAN COUNTIES

LABORERS:

ZONE 1:

GROUP 1	17.66	5.50
GROUP 2	19.76	5.50
GROUP 3	20.03	5.50
GROUP 4	20.30	5.50
GROUP 5	20.58	5.50
GROUP 6	21.95	5.50

Zone Differential (Add to Zone 1
rate): \$2.00

BASE POINTS: Spokane, Moses Lake, Pasco, Lewiston

Zone 1: 0-45 radius miles from the main post office.

Zone 2: 45 radius miles and over from the main post
office.

LABORERS CLASSIFICATIONS

GROUP 1: Flagman; Landscape Laborer; Scaleman; Traffic
Control

Maintenance Laborer (to include erection and maintenance of
barricades, signs and relief of flagperson); Window
Washer/Cleaner (detail cleanup, such as, but not limited to
cleaning floors, ceilings, walls, windows, etc. prior to
final
acceptance by the owner)

GROUP 2: Asbestos Abatement Worker; Brush Hog Feeder;
Carpenter
Tender; Cement Handler; Clean-up Laborer; Concrete Crewman
(to
include stripping of forms, hand operating jacks on slip
form
construction, application of concrete curing compounds,
pumpcrete

machine, signaling, handling the nozzle of squeezecrete or similar machine, 6 inches and smaller); Confined Space Attendant; Concrete Signalman; Crusher Feeder; Demolition (to include clean-up, burning, loading, wrecking and salvage of all material); Dumpman; Fence Erector; Firewatch; Form Cleaning Machine Feeder, Stacker; General Laborer; Grout Machine Header Tender; Guard Rail (to include guard rails, guide and reference posts, sign posts, and right-of-way markers); Hazardous Waste Worker, Level D (no respirator is used and skin protection is minimal); Miner, Class "A" (to include all bull gang, concrete crewman, dumpman and pumpcrete crewman, including distributing pipe, assembly & dismantle, and nipper); Nipper; Riprap Man; Sandblast Tailhooseman; Scaffold Erector (wood or steel); Stake Jumper; Structural Mover (to include separating foundation, preparation, cribbing, shoring, jacking and unloading of structures); Tailhooseman (water nozzle); Timber Bucker and Faller (by hand); Track Laborer (RR); Truck Loader; Well-Point Man; All Other Work Classifications Not Specially Listed Shall Be Classified As General Laborer

GROUP 3: Asphalt Raker; Asphalt Roller, walking; Cement Finisher Tender; Concrete Saw, walking; Demolition Torch; Dope Pot Firemen, non-mechanical; Driller Tender (when required to move and position machine); Form Setter, Paving; Grade Checker using level; Hazardous Waste Worker, Level C (uses a chemical "splash suit" and air purifying respirator); Jackhammer Operator; Miner, Class "B" (to include brakeman, finisher, vibrator, form setter); Nozzleman (to include squeeze and flo-crete nozzle);

Nozzleman, water, air or steam; Pavement Breaker (under 90 lbs.); Pipelayer, corrugated metal culvert; Pipelayer, multi-plate; Pot Tender; Power Buggy Operator; Power Tool Operator, gas, electric, pneumatic; Railroad Equipment, power driven, except dual mobile power spiker or puller; Railroad Power Spiker or Puller, dual mobile; Rodder and Spreader; Tamper (to include operation of Barco, Essex and similar tampers); Trencher, Shawnee; Tugger Operator; Wagon Drills; Water Pipe Liner; Wheelbarrow (power driven)

GROUP 4: Air and Hydraulic Track Drill; Brush Machine (to include horizontal construction joint cleanup brush machine, power propelled); Caisson Worker, free air; Chain Saw Operator and Faller; Concrete Stack (to include laborers when laborers working on free standing concrete stacks for smoke or fume control above 40 feet high); Guniting (to include operation of machine and nozzle); Hazardous Waste Worker, Level B (uses same respirator protection as Level A. A supplied air line is provided in conjunction with a chemical "splash suit"); High Scaler; Laser Beam Operator (to include grade checker and elevation control); Miner, Class C (to include miner, nozzleman for concrete, laser beam operator and rigger on tunnels); Monitor Operator (air track or similar mounting); Mortar Mixer; Nozzleman (to include jet blasting nozzleman, over 1,200 lbs., jet blast machine power propelled, sandblast nozzle); Pavement Breaker (90 lbs. and over); Pipelayer (to include working topman, caulker, collarman, jointer, mortarman, rigger, jacker, shorer, valve or meter installer); Pipewrapper; Plasterer Tender; Vibrators (all)

GROUP 5 - Drills with Dual Masts; Hazardous Waste Worker,
Level
A (utilizes a fully encapsulated suit with a self-contained
breathing apparatus or a supplied air line); Miner Class
"D", (to
include raise and shaft miner, laser beam operator on
riases and
shafts)

GROUP 6 - Powderman

LAB00238G 06/01/2002

Rates

Fringes
COUNTIES EAST OF THE 120TH MERIDIAN: ADAMS, ASOTIN,
BENTON,
COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT,
LINCOLN,
OKANOGAN, PEND OREILLE, STEVENS, SPOKANE, WALLA WALLA,
WHITMAN

HOD CARRIERS	21.55	5.50
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LAB00335A 06/01/2002

Rates

Fringes
CLARK, COWLITZ, KLINKITAT, PACIFIC (SOUTH OF A STRAIGHT
LINE MADE
BY EXTENDING THE NORTH BOUNDARY LINE OF WAHIAKUM COUNTY
WEST TO
THE PACIFIC OCEAN), SKAMANIA AND WAHIAKUM COUNTIES

ZONE 1:
LABORERS:

GROUP 1	23.43	6.15
GROUP 2	23.94	6.15
GROUP 3	24.33	6.15
GROUP 4	24.66	6.15
GROUP 5	21.26	6.15
GROUP 6	19.16	6.15
GROUP 7	16.40	6.15

Zone Differential (Add to Zone 1 rates):

Zone 2 \$ 0.65
Zone 3 - 1.15
Zone 4 - 1.70
Zone 5 - 2.75

BASE POINTS: GOLDENDALE, LONGVIEW, AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city all.

ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.

ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.

ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.

ZONE 5: More than 80 miles from the respective city hall.

LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Plant Laborers; Asphalt Spreaders; Batch Weighman; Broomers; Brush Burners and Cutters; Car and Truck Loaders; Carpenter Tender; Change-House Man or Dry Shack Man; Choker Setter; Clean-up Laborers; Curing, Concrete; Demolition, Wrecking and Moving Laborers; Dumpers, road oiling crew; Dumpmen (for grading crew); Elevator Feeders; Guard Rail, Median Rail Reference Post, Guide Post, Right of Way Marker; Fine Graders; Fire Watch; Form Strippers (not swinging stages); General Laborers; Hazardous Waste Worker; Leverman or Aggregate Spreader (Flaherty and similar types); Loading Spotters; Material Yard Man (including electrical); Pittsburgh Chipper Operator or Similar Types; Railroad Track Laborers; Ribbon Setters (including steel forms); Rip Rap Man (hand placed); Road Pump Tender; Sewer Labor; Signalman; Skipman; Slopers; Spraymen; Stake Chaser; Stockpiler;

Tie Back Shoring; Timber Faller and Bucker (hand labor);
Toolroom
Man (at job site); Tunnel Bullgang (above ground); Weight-
Man-
Crusher (aggregate when used)

GROUP 2: Applicator (including pot power tender for
same),
applying protective material by hand or nozzle on utility
lines
or storage tanks on project; Brush Cutters (power saw);
Burners;
Choker Splicer; Clary Power Spreader and similar types;
Clean-
up Nozzleman-Green Cutter (concrete, rock, etc.); Concrete
Power Buggyman; Concrete Laborer; Crusher Feeder;
Demolition and
Wrecking Charred Materials; Guniting Nozzleman Tender; Guniting
or
Sand Blasting Pot Tender; Handlers or Mixers of all
Materials of
an irritating nature (including cement and lime); Tool
Operators
(includes but not limited to: Dry Pack Machine;
Jackhammer;
Chipping Guns; Paving Breakers); Pipe Doping and Wrapping;
Post
Hole Digger, air, gas or electric; Vibrating Screed;
Tampers;
Sand Blasting (Wet); Stake-Setter; Tunnel-Muckers,
Brakemen,
Concrete Crew, Bullgang (underground)

GROUP 3: Asbestos Removal; Bit Grinder; Drill Doctor;
Drill
Operators, air tracks, cat drills, wagon drills, rubber-
mounted
drills, and other similar types including at crusher
plants;
Guniting Nozzleman; High Scalars, Strippers and Drillers
(covers
work in swinging stages, chairs or belts, under extreme
conditions unusual to normal drilling, blasting, barring-
down, or
sloping and stripping); Manhole Builder; Powdermen;
Concrete Saw
Operator; Powdermen; Power Saw Operators (Bucking and
Falling);

Pumpcrete Nozzlemen; Sand Blasting (Dry); Sewer Timberman;
Track
Liners, Anchor Machines, Ballast Regulators, Multiple
Tampers,
Power Jacks, Tugger Operator; Tunnel-Chuck Tenders, Nippers
and
Timbermen; Vibrator; Water Blaster

GROUP 4: Asphalt Raker; Concrete Saw Operator (walls);
Concrete Nozzelman; Grade Checker; Pipelayer; Laser Beam
(pipelaying)-applicable when employee assigned to move, set
up,
align; Laser Beam; Tunnel Miners; Motorman-Dinky
Locomotive-Tunnel; Powderman-Tunnel; Shield Operator-Tunnel

GROUP 5: Traffic Flaggers

GROUP 6: Fence Builders

GROUP 7: Landscaping or Planting Laborers

LAB00335L 06/01/2002

Rates

Fringes
CLARK, COWLITZ, KLINKITAT, PACIFIC (SOUTH OF A STRAIGHT
LINE MADE
BY EXTENDING THE NORTH BOUNDARY LINE OF WAHIAKUM COUNTY
WEST TO
THE PACIFIC OCEAN), SKAMANIA AND WAHIAKUM COUNTIES

HOD CARRIERS	25.04	6.15

PAIN0005B 06/01/2002

Rates

Fringes
STATEWIDE EXCEPT CLARK, COWLITZ, KLINKITAT, PACIFIC
(SOUTH),
SKAMANIA, AND WAHIAKUM COUNTIES

STRIPERS	21.25	6.40

PAIN0005D 07/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP,
LEWIS,
MASON, PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND
WHATCOM
COUNTIES

PAINTERS	23.27	5.36
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PAIN0005G 07/01/2002

Rates

Fringes

ADAMS, ASOTIN; BENTON AND FRANKLIN (EXCEPT HANFORD SITE);
CHELAN,
COLUMBIA, DOUGLAS, FERRY, GARFIELD, GRANT, KITTITAS,
LINCOLN,
OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA,
WHITMAN AND YAKIMA COUNTIES

PAINTERS*:

Brush, Roller, Striping,		
Steam-cleaning and Spray	19.42	4.42
Application of Cold Tar		
Products, Epoxies, Polyure		
thanes, Acids, Radiation		
Resistant Material, Water and		
Sandblasting, Bridges, Towers,		
Tanks, Stacks, Steeples	20.42	4.42
TV Radio, Electrical Transmission		
Towers	21.17	4.42
Lead Abatement, Asbestos		
Abatement	20.42	4.42

*\$.70 shall be paid over and above the basic wage rates
listed
for work on swing stages and high work of over 30 feet.

* PAIN0055C 07/01/2002

Rates

Fringes

CLARK, COWLITZ, KLUCKITAT, PACIFIC, SKAMANIA, AND WAHIAKUM
COUNTIES

PAINTERS:

Brush & Roller	17.35	5.08
Spray and Sandblasting	17.95	5.08
High work - All work		
60 ft. or higher	18.10	5.08

PAIN0055L 06/01/2002

Rates

Fringes

CLARK, COWLITZ, KLINKITAT, SKAMANIA and WAHIAKUM COUNTIES

PAINTERS:

HIGHWAY AND PARKING LOT		
STRIPER	23.36	5.75

PLAS0072E 06/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY,
FRANKLIN, GARFIELD, GRANT, KITTITAS, LINCOLN, OKANOGAN,
PEND
OREILLE, SPOKANE, STEVENS, WALLA WALLA, WHITMAN, AND
YAKIMA COUNTIES

ZONE 1:

CEMENT MASONS	22.33	5.98
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Zone Differential (Add to Zone 1
rate): Zone 2 - \$2.00

BASE POINTS: Spokane, Pasco, Moses Lake, Lewiston

Zone 1: 0 - 45 radius miles from the main post office

Zone 2: Over 45 radius miles from the main post office

PLAS0528A 12/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP,
LEWIS,

MASON, PACIFIC (NORTH), PIERCE, SAN JUAN, SKAGIT,
SNOHOMISH,
THURSTON, AND WHATCOM COUNTIES

CEMENT MASON	28.05	9.84
COMPOSITION, COLOR MASTIC, TROWEL MACHINE, GRINDER, POWER TOOLS, GUNNITE NOZZLE	28.30	9.84

PLAS0555B 06/01/2002

Rates

Fringes

CLARK, COWLITZ, KLUCKITAT, PACIFIC (SOUTH), SKAMANIA, AND
WAHIAKUM COUNTIES

ZONE 1:

CEMENT MASONS	24.24	9.70
COMPOSITION WORKERS AND POWER MACHINERY OPERATORS	24.68	9.70
CEMENT MASONS ON SUSPENDED, SWINGING AND/OR HANGING SCAFFOLD	24.68	9.70
CEMENT MASONS DOING BOTH COMPOSITION/POWER MACHINERY AND SUSPENDED/HANGING SCAFFOLD	25.13	9.70

Zone Differential (Add To Zone 1 Rates):

Zone 2 - \$0.65

Zone 3 - 1.15

Zone 4 - 1.70

Zone 5 - 2.75

BASE POINTS: BEND, CORVALLIS, EUGENE, LONGVIEW, MEDFORD,
PORTLAND, SALEM, THE DALLES, VANCOUVER

ZONE 1: Projects within 30 miles of the respective city
hall

ZONE 2: More than 30 miles but less than 40 miles from the
respective city hall.

ZONE 3: More than 40 miles but less than 50 miles from the
respective city hall.

ZONE 4: More than 50 miles but less than 80 miles from the
respective city hall.

ZONE 5: More than 80 miles from the respective city hall

PLUM0032B 01/01/2002

Rates

Fringes
CLALLAM, KING AND JEFFERSON COUNTIES

PLUMBERS AND PIPEFITTERS	32.08	11.53
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PLUM0032D 06/01/2002

Rates

Fringes
CHELAN, KITTITAS (NORTHERN TIP), DOUGLAS (NORTH), AND
OKANOGAN
(NORTH) COUNTIES

PLUMBERS AND PIPEFITTERS	26.13	10.23
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PLUM0044C 06/01/2002

Rates

Fringes
ADAMS (NORTHERN PART), ASOTIN (CLARKSTON ONLY), FERRY
(EASTERN
PART), LINCOLN (EASTERN PART), PEND ORIELLE, STEVENS,
SPOKANE,
AND WHITMAN COUNTIES

PLUMBERS AND PIPEFITTERS	26.16	9.89
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PLUM0082A 08/01/2002

Rates

Fringes
CLARK (NORTHERN TIP INCLUDING WOODLAND), COWLITZ, GRAYS
HARBOR,
LEWIS, MASON (EXCLUDING NE SECTION), PACIFIC, PIERCE
SKAMANIA, THURSTON AND WAHKIAKUM COUNTIES

PLUMBERS AND PIPEFITTERS	29.60	11.62
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PLUM0265C 08/01/2002

Rates

Fringes

ISLAND, SKAGIT, SNOHOMISH, SAN JUAN AND WHATCOM COUNTIES

PLUMBERS AND PIPEFITTERS	29.00	11.62
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PLUM0290K 10/01/2002

Rates

Fringes

CLARK (ALL EXCLUDING NORTHERN TIP INCLUDING CITY OF
WOODLAND)

PLUMBERS AND PIPEFITTERS	31.73	12.93
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PLUM0598E 06/01/2002

Rates

Fringes

ADAMS (SOUTHERN PART), ASOTIN (EXCLUDING THE CITY OF
CLARKSTON),
BENTON, COLUMBIA, DOUGLAS (EASTERN HALF), FERRY (WESTERN
PART),
FRANKLIN, GARFIELD, GRANT, KITTITAS (ALL BUT NORTHERN
TIP),
KLICKITAT, LINCOLN (WESTERN PART), OKANOGAN (EASTERN),
WALLA
WALLA AND YAKIMA COUNTIES

PLUMBERS	29.85	12.59
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PLUM0631A 08/01/2002

Rates

Fringes

MASON (NE SECTION),
AND KITSAP COUNTIES

PLUMBERS/PIPEFITTERS:

All new construction, additions,
and remodeling of commercial
building projects such as:
cocktail lounges and taverns,

professional buildings, medical clinics, retail stores, hotels and motels, restaurants and fast food types, gasoline service stations, and car washes where the plumbing and mechanical cost of the project is less than \$100,000	19.20	4.58
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All other work where the plumbing and mechanical cost of the project is \$100,000 and over	27.84	11.62

TEAM0037C 06/01/2002

Rates

Fringes
 CLARK, COWLITZ, KLINKITAT, PACIFIC (South of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), SKAMANIA, AND WAHAKIAKUM COUNTIES

TRUCK DRIVERS

ZONE 1:		
GROUP 1	23.65	8.45
GROUP 2	23.77	8.45
GROUP 3	23.90	8.45
GROUP 4	24.16	8.45
GROUP 5	24.38	8.45
GROUP 6	24.54	8.45
GROUP 7	24.74	8.45

Zone Differential (Add to Zone 1 Rates):

Zone 2 - \$0.65
Zone 3 - 1.15
Zone 4 - 1.70
Zone 5 - 2.75

BASE POINTS: ASTORIA, THE DALLES, LONGVIEW AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city hall.
 ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.
 ZONE 3: More than 40 miles but less than 50 miles from the

respective city hall.
ZONE 4: More than 50 miles but less than 80 miles from the
respective city hall.
ZONE 5: More than 80 miles from the respective city hall.

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: A Frame or Hydra lift truck w/load bearing
surface;
Articulated dump truck; Battery Rebuilders; Bus or Manhaul
Driver; Concrete Buggies (power operated); Concrete pump
truck;
Dump Trucks, side, end and bottom dumps, including Semi
Trucks
and Trains or combinations there of: up to and including 10
cu.
yds.; Lift Jitneys, Fork Lifts (all sizes in loading,
unloading
and transporting material on job site); Loader and/or
Leverman on
Concrete Dry Batch Plant (manually operated); Pilot Car;
Pickup truck; Solo Flat Bed and misc. Body Trucks, 0-10
tons;
Truck Tender; Truck Mechanic Tender; Water Wagons (rated
capacity) up to 3,000 gallons; Transit Mix and Wet or Dry
Mix - 5
cu. yds. and under; Lubrication Man, Fuel Truck Driver,
Tireman,
Wash Rack, Steam Cleaner or combinations; Team Driver;
Slurry
Truck Driver or Leverman; Tireman

GROUP 2: Boom truck/hydra lift or retracting crane;
Challenger;
Dumpsters or similar equipment all sizes; Dump
Trucks/articulated
dumps 6 cu to 10 cu.; Flaherty Spreader Driver or Leverman;
Lowbed Equipment, Flat Bed Semi-trailer or doubles
transporting
equipment or wet or dry materials; Lumber Carrier,
Driver-Straddle Carrier (used in loading, unloading and
transporting of materials on job site); Oil Distributor
Driver or
Leverman; Transit mix and wet or dry mix trucks: over 5 cu.
yds.
and including 7 cu. yds.; Vacuum trucks; Water truck/Wagons
(rated capacity) over 3,000 to 5,000 gallons

GROUP 3: Ammonia nitrate distributor driver; Dump trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 10 cu. yds. and including 30 cu. yds. includes Articulated dump trucks; Selfpropelled street sweeper; Transit mix and wet or dry mix truck: over 7 cu yds. and including 11 cu yds.; Truck Mechanic Welder Body Repairman; Utility and cleanup truck; Water Wagons (rated capacity) over 5,000 to 10,000 gallons

GROUP 4: Asphalt burner; Dump Trucks, side, end and bottom dumps, including Semi-Trucks and Trains or combinations thereof: over 30 cu. yds. and including 50 cu. yds. includes articulated dump trucks; Fire guard; Transit Mix and Wet or Dry Mix Trucks, over 11 cu. yds. and including 15 cu. yds.; Water Wagon (rated capacity) over 10,000 gallons to 15,000 gallons

GROUP 5: Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 50 cu. yds. and including 60 cu. yds. includes articulated dump trucks

GROUP 6: Bulk cement spreader w/o auger; Dry prebatch concrete mix trucks; Dump trucks, side, end and bottom dumps, including Semi Trucks and Trains of combinations thereof: over 60 cu. yds. and including 80 cu. yds., and includes articulated dump trucks; Skid truck

GROUP 7: Dump Trucks, side, end and bottom dumps, including Semi Trucks and Trains or combinations thereof: over 80 cu. yds. and including 100 cu. yds., includes articulated dump trucks; Industrial lift truck (mechanical tailgate)

TEAM0174A 06/01/2002

Rates

Fringes
CLALLAM, GRAYS HARBOR, ISLAND, JEFFERSON, KING, KITSAP,
LEWIS,
MASON, PACIFIC (North of a straight line made by extending
the
north boundary line of Wahkiakum County west to the Pacific
Ocean), PIERCE, SAN JUAN, SKAGIT, SNOHOMISH, THURSTON AND
WHATCOM COUNTIES

TRUCK DRIVERS;

ZONE A:

GROUP 1:	25.79
9.68	
GROUP 2:	25.21
9.68	
GROUP 3:	22.81
9.68	
GROUP 4:	18.56
9.68	
GROUP 5:	25.55
9.68	

ZONE B (25-45 miles from center of listed cities*):

Add \$.70 per hour to Zone A rates.

ZONE C (over 45 miles from centr of listed cities*):

Add \$1.00 per hour to Zone A rates.

*Zone pay will be calculated from the city center of the
following listed cities:

BELLINGHAM	CENTRALIA	RAYMOND	OLYMPIA
EVERETT	SHELTON	ANACORTES	BELLEVUE
SEATTLE	PORT ANGELES	MT. VERNON	KENT
TACOMA	PORT TOWNSEND	ABERDEEN	BREMERTON

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1 -"A-frame or Hydralift" trucks and Boom trucks or
similar equipment when "A" frame or "Hydralift" and Boom
truck or

similar equipment is used; Buggymobile; Bulk Cement Tanker;
Dumpsters and similar equipment, Tournorockers,
Tournowagon,

Tournotrailer, Cat DW series, Terra Cobra, Le Tourneau, Westinghouse, Athye Wagon, Euclid Two and Four-Wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump Trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with 16 yards to 30 yards capacity: Over 30 yards \$.15 per hour additional for each 10 yard increment; Explosive Truck (field mix) and similar equipment; Hyster Operators (handling bulk loose aggregates); Lowbed and Heavy Duty Trailer; Road Oil Distributor Driver; Spreader, Flaherty Transit mix used exclusively in heavy construction; Water Wagon and Tank Truck-3,000 gallons and over capacity

GROUP 2 - Bulllifts, or similar equipment used in loading or unloading trucks, transporting materials on job site; Dumpsters, and similar equipment, Tournorockers, Tournowagon, Turnotrailer, Cat. D.W. Series, Terra Cobra, Le Tourneau, Westinghouse, Athye wagon, Euclid two and four-wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with less than 16 yards capacity; Flatbed (Dual Rear Axle); Grease Truck, Fuel Truck, Greaser, Battery Service Man and/or Tire Service Man; Leverman and loader at bunkers and batch plants; Oil tank transport; Scissor truck; Slurry Truck; Sno-Go and similar equipment; Swampers; Straddler Carrier (Ross, Hyster) and similar equipment; Team Driver; Tractor (small, rubber-tired)(when used within Teamster jurisdiction); Vacuum truck; Water Wagon and Tank trucks-less

than 3,000 gallons capacity; Winch Truck; Wrecker, Tow truck and similar equipment

GROUP 3 - Flatbed (single rear axle); Pickup Sweeper; Pickup Truck. (Adjust Group 3 upward by \$2.00 per hour for onsite work only)

GROUP 4 - Escort or Pilot Car

GROUP 5 - Mechanic

HAZMAT PROJECTS

Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the classification working in as follows:

LEVEL C: +\$.25 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B: +\$.50 per hour - Uses same respirator protection as

Level A. Supplied air line is provided in conjunction with a chemical "splash suit."

LEVEL A: +\$.75 per hour - This level utilizes a fully-encapsulated suit with a self-contained breathing apparatus or a supplied air line.

TEAM0760C 06/01/2002

Rates

Fringes

ADAMS, ASOTIN, BENTON, CHELAN, COLUMBIA, DOUGLAS, FERRY, FRANKLIN, GARFIELD, GRANT KITTITAS, LINCOLN, OKANOGAN, PEND OREILLE, SPOKANE, STEVENS, WALLA WALLA, AND WHITMAN COUNTIES

TRUCK DRIVERS

(ANYONE WORKING ON HAZMAT JOBS SEE FOOTNOTE A BELOW)

ZONE 1: (INCLUDES ALL OF YAKIMA COUNTY)

GROUP 1	17.73	8.50
GROUP 2	20.00	8.50
GROUP 3	20.50	8.50
GROUP 4	20.83	8.50
GROUP 5	20.94	8.50
GROUP 6	21.11	8.50
GROUP 7	21.64	8.50
GROUP 8	21.97	8.50

Zone Differential (Add to Zone 1
rate: Zone 2 - \$2.00)

BASE POINTS: Spokane, Moses Lake, Pasco, Lewiston

Zone 1: 0-45 radius miles from the main post office.

Zone 2: 45 radius miles and over from the main post office

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Escort Driver or Pilot Car; Employee Haul; Power Boat
Hauling Employees or Material

GROUP 2: Fish Truck; Flat Bed Truck; Fork Lift (3000 lbs. and under); Leverperson (loading trucks at bunkers); Trailer Mounted Hydro Seeder and Mulcher; Seeder & Mulcher; Stationary Fuel Operator; Tractor (small, rubber-tired, pulling trailer or similar equipment)

GROUP 3: Auto Crane (2000 lbs. capacity); Buggy Mobile & Similar; Bulk Cement Tanks & Spreader; Dumptor (6 yds. & under); Flat Bed Truck with Hydraulic System; Fork Lift (3001-16,000 lbs.); Fuel Truck Driver, Steamcleaner & Washer; Power Operated Sweeper; Rubber-tired Tunnel Jumbo; Scissors Truck; Slurry Truck Driver; Straddle Carrier (Ross, Hyster, & similar); Tireperson; Transit Mixers & Truck Hauling Concrete (3 yd. to & including 6 yds.); Trucks, side, end, bottom & articulated end dump (3 yards

to and including 6 yds.); Warehouseperson (to include shipping & receiving); Wrecker & Tow Truck

GROUP 4: A-Frame; Burner, Cutter, & Welder; Service Greaser; Trucks, side, end, bottom & articulated end dump (over 6 yards to and including 12 yds.); Truck Mounted Hydro Seeder; Warehouseperson; Water Tank truck (0-8,000 gallons)

GROUP 5: Dumptor (over 6 yds.); Lowboy (50 tons & under); Self-loading Roll Off; Semi-Truck & Trailer; Tractor with Steer Trailer; Transit Mixers and Trucks Hauling Concrete (over 6 yds.

to and including 10 yds.); Trucks, side, end, bottom and end dump (over 12 yds. to & including 20 yds.); Truck-Mounted Crane (with load bearing surface either mounted or pulled, up to 14 ton); Vacuum Truck (super sucker, guzzler, etc.)

GROUP 6: Flaherty Spreader Box Driver; Flowboys; Fork Lift (over 16,000 lbs.); Dumps (Semi-end); Mechanic (Field); Semi-end Dumps; Transfer Truck & Trailer; Transit Mixers & Trucks Hauling Concrete (over 10 yds. to & including 20 yds.); Trucks, side, end, bottom and articulated end dump (over 20 yds. to & including 40 yds.); Truck and Pup; Tournarocker, DW's & similar with 2 or more 4 wheel-power tractor with trailer, gallonage or yardage scale, whichever is greater Water Tank Truck (8,001-14,000 gallons)

GROUP 7: Oil Distributor Driver; Stringer Truck (cable operated trailer); Transit Mixers & Trucks Hauling Concrete (over 20 yds.); Truck, side, end, bottom end dump (over 40 yds. to & including 100 yds.); Truck Mounted Crane (with load bearing surface either mounted or pulled (16 through 25 tons);

GROUP 8: Prime Movers and Stinger Truck; Trucks, side, end, bottom and articulated end dump (over 100 yds.); Helicopter Pilot Hauling Employees or Materials

Footnote A - Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the classification working in as follows:

LEVEL C-D: - \$.50 PER HOUR (This is the lowest level of protection. This level may use an air purifying respirator or additional protective clothing.
LEVEL A-B: - \$1.00 PER HOUR (Uses supplied air in conjunction with a chemical splash suit or fully encapsulated suit with a self-contained breathing apparatus.

NOTE: Trucks Pulling Equipment Trailers: shall receive \$.15/hour over applicable truck rate

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.

Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor

200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

GENERAL DECISION **WA020002** 01/17/2003 WA2

Date: January 17, 2003

General Decision Number **WA020002**

Superseded General Decision No. WA010002

State: Washington

Construction Type:
BUILDING

County(ies):

CHELAN

KITSAP

PIERCE

CLALLAM

KITTITAS

SNOHOMISH

GRAYS HARBOR

LEWIS

THURSTON

JEFFERSON

MASON

KING

PACIFIC

BUILDING CONSTRUCTION PROJECTS (does not include
residential
construction consisting of single family homes and
apartments up
to and including 4 stories)

Modification Number	Publication Date
0	03/01/2002
1	03/08/2002
2	03/22/2002
3	03/29/2002
4	04/05/2002
5	04/19/2002
6	05/03/2002
7	05/10/2002
8	06/07/2002
9	06/21/2002
10	07/05/2002
11	07/12/2002
12	07/19/2002
13	08/09/2002
14	08/30/2002
15	09/06/2002
16	09/13/2002
17	09/27/2002
18	01/03/2003
19	01/17/2003

COUNTY(ies):

CHELAN

CLALLAM

GRAYS HARBOR

JEFFERSON

KING

KITSAP

KITTITAS

LEWIS

MASON

PACIFIC

PIERCE

SNOHOMISH

THURSTON

* ASBE0007A 06/01/2002

Rates

Fringes

ASBESTOS WORKERS/INSULATORS:

(Includes application of all
insulating materials, protective
coverings, coating and finishes
to all types of mechanical
systems)

31.07

6.86

BOIL0242B 10/01/2002

Rates

Fringes

CHELAN AND KITTITAS COUNTIES

BOILERMAKERS

27.22

13.30

BOIL0502B 10/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,
MASON, PACIFIC, PIERCE, SNOHOMISH AND THURSTON COUNTIES

BOILERMAKERS

27.22

13.55

BRWA0001A 08/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,
MASON,
PACIFIC (northern part), PIERCE, SNOHOMISH AND THURSTON
COUNTIES

BRICKLAYERS	29.02	7.85
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BRWA0001F 06/01/2002

Rates

Fringes

PACIFIC COUNTY (SOUTHERN PART)

BRICKLAYERS	26.62	10.10
MARBLE MASONS	27.62	10.10

BRWA0001G 05/01/2002

Rates

Fringes

PACIFIC (SOUTHERN PORTION) COUNTY

TILE SETTER AND TERRAZZO WORKERS	23.90	8.23
TILE AND TERRAZZO FINISHERS	17.99	6.27

BRWA0001H 08/01/2002

Rates

Fringes

CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,
MASON,
PACIFIC (NORTHERN HALF), PIERCE, THURSTON AND SNOHOMISH
COUNTIES

TILE AND TERRAZZO WORKERS	26.44	7.79
TILE AND TERRAZZO FINISHERS	20.72	7.34

BRWA0003A 06/01/2002

Rates

Fringes

CHELAN AND KITTITAS COUNTIES

BRICKLAYERS	23.16	8.81
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BRWA0003E 07/01/2001

	Rates	
Fringes		
CLELAN AND KITTITAS		
TILE AND TERRAZZO FINISHERS	14.70	5.83

BRWA0003F 07/01/2001

	Rates	
Fringes		
CLELAN AND KITTITAS		
TERRAZZO WORKERS & TILE LAYER	18.50	5.83

CARP0770E 06/01/2002

	Rates	
Fringes		
WESTERN WASHINGTON: CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC (NORTH), PIERCE, SNOHOMISH AND THURSTON COUNTIES		
CARPENTERS AND DRYWALL APPLICATORS	27.95	8.05
CARPENTERS ON CREOSOTE MATERIAL	28.05	8.05
INSULATION APPLICATORS	25.50	8.05
SAWFILERS, STATIONARY POWER SAW OPERATORS, FLOOR FINISHER, FLOOR LAYER, SHINGLER, FLOOR SANDER OPERATORS OF OTHER STATIONARY WOOD WORKING TOOLS	28.08	8.05
MILLWRIGHT AND MACHINE ERECTORS	28.95	8.05
ACOUSTICAL WORKERS	28.11	8.05
PILEDRIIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING OR CRESOTE TREATED MATERIAL, ALL PILING	28.15	8.05
PILDRIVER, BRIDGE DOCK &		
WHARF CARPENTERS	27.95	8.05
DIVERS	68.97	8.05
DIVERS TENDER	30.68	8.05

(HOURLY ZONE PAY:WESTERN WASHINGTON AND CENTRAL WASHINGTON
CARPENTERS ONLY)

Hourly Zone Pay shall be paid on jobs located outside of the free zone computed from the city center of the following listed cities:

Seattle	Olympia	Bellingham
Auburn	Bremerton	Anacortes
Renton	Shelton	Yakima
Aberdeen-Hoquiam	Tacoma	Wenatchee
Ellensburg	Everett	Port Angeles
Centralia	Mount Vernon	Sunnyside
Chelan	Pt. Townsend	

Zone Pay		
0 -25	radius miles	Free
25-35	radius miles	\$1.00/hour
35-45	radius miles	\$1.15/hour
45-55	radius miles	\$1.35/hour
Over 55	radius miles	\$1.55/hour

(HOURLY ZONE PAY:WESTERN AND CENTRAL WASHINGTON-MILLWRIGHTS AND
PILEDRIERS ONLY)

Hour Zone Pay shall be computed from Seattle Union Hall, Tacoma City center, and Everett City center

Zone Pay		
0 -25	radius miles	Free
25-45	radius miles	\$.70/hour
Over 45	radius miles	\$1.50/hour

Millwrights and Piledriers who reside in Aberdeen, Bellingham, Port Angeles, Mount Vernon, Olympia, Wenatchee, or Yakima Local Union jurisdiction areas, working on jobs in their respective area, shall have their Zone Pay measured from their respective city center

CENTRAL WASHINGTON: CHELAN AND KITTITAS COUNTIES

CARPENTERS AND DRYWALL APPLICATORS	20.72	7.82
CARPENTERS ON CREOSOTED MATERIALS	20.82	7.82
INSULATION APPLICATORS	20.72	7.82
SAWFILER, STATIONARY POWER SAW OPERATORS, FLOOR FINISHER, FLOOR LAYER, SHINGLERS, FLOOR SANDER OPERATOR AND OPERATORS OF		

OTHER STATIONARY WOOD WORKING TOOLS	20.85	7.82
MILLWRIGHTS AND MACHINE ERECTORS	28.95	7.82
ACCOUSTICAL WORKERS	20.98	7.82
PILDRIVER, DRIVING, PULLING, CUTTING, PLACING COLLARS, SETTING, WELDING, OR CREOSOTE TREATED MATERIAL, ALL PILING	28.15	7.82
PILEDRIIVER, BRIDGE DOCK & WHARF CARPENTERS	27.95	7.82
DIVERS	68.97	8.05
DIVERS TENDER	30.68	8.05

CARP9003A 06/01/2002

Rates

Fringes
PACIFIC COUNTY (South of a straight line made by extending
the
north boundary line of Wahkiakum County west to Willapa Bay
to
the Pacific Ocean, and thence north through the natural
waterway
to the Pacific Ocean (this will include the entire
peninsula west
of Willapa Bay)

SEE ZONE DESCRIPTION FOR CITIES BASE POINTS

ZONE 1:

CARPENTERS	27.37	8.80
DRYWALL, ACOUSTICAL & LATHERS	27.37	8.80
FLOOR LAYERS & FLOOR FINISHERS (the laying of all hardwood floors nailed and mastic set, parquet and wood-type tiles, and block floors, the sanding and finishing of floors, the prepara- tion of old and new floors when the materials mentioned above are to be installed; INSULATORS (fiberglass and similar irritating material)	27.52	8.80
MILLWRIGHTS	27.87	8.80
PILEDRIIVERS	27.87	8.80
DIVERS	65.05	8.80

DIVERS TENDERS	29.91	8.80
Zone Differential (Add to Zone 1 rates):		
Zone 2 -	\$0.85	
Zone 3 -	1.25	
Zone 4 -	1.70	
Zone 5 -	2.00	
Zone 6 -	3.00	

BASEPOINTS: GOLDENDALE, LONGVIEW, AND VANCOUVER

ZONE 1: Projects located within 30 miles of the respective city hall of the above mentioned cities

ZONE 2: Projects located more than 30 miles and less than 40 miles of the respective city of the above mentioned cities

ZONE 3: Projects located more than 40 miles and less than 50 miles of the respective city of the above mentioned cities

ZONE 4: Projects located more than 50 miles and less than 60 miles of the respective city of the above mentioned cities.

ZONE 5: Projects located more than 60 miles and less than 70 miles of the respective city of the above mentioned cities

ZONE 6: Projects located more than 70 miles of the respected city of the above mentioned cities

ELEC0046B 12/30/2002

Rates

Fringes

CALLAM, JEFFERSON, KING AND KITSAP COUNTIES

ELECTRICIANS	31.50
3%+8.88	
CABLE SPLICERS	34.65
3%+8.88	

ELEC0046C 06/01/2001

	Rates	
Fringes		
CALLAM, JEFFERSON, KING, KITSAP COUNTIES		
SOUND AND COMMUNICATION		
TECHNICIAN	20.11	4.59

SCOPE OF WORK

Includes the installation, testing, service and maintenance, of the following systems which utilize the transmission and/or transference of voice, sound vision and digital for commercial, education, security and entertainment purposes for the following:

TV monitoring and surveillance, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms, fire alarms and life safety systems (hang, terminate devices and panels and to conduct functional and systems tests), and low voltage master clock systems.

WORK EXCLUDED

Raceway systems are not covered (excluding Ladder-Rack for the purpose of the above listed systems). Chases and/or nipples (not to exceed 10 feet) may be installed on open wiring systems.

Energy management systems.

SCADA (Supervisory Control and Data Acquisition) when not intrinsic to the above listed systems (in the scope).

ELEC0076A 07/01/2002

	Rates	
Fringes		
GRAYS HARBOR, LEWIS, MASON, PACIFIC, PIERCE, THURSTON COUNTIES		

ELECTRICIANS	29.78
3%+11.01	
CABLE SPLICERS	32.76
3%+11.01	

ELEC0076D 06/01/2000

Rates

Fringes
 GRAYS HARBOR, LEWIS, MASON, PACIFIC, PIERCE AND THURSTON
 COUNTIES

SOUND AND COMMUNICATIONS		
TECHNICIAN	18.59	5.24

SCOPE OF WORK

Includes the installation, testing, service and maintenance, of the following systems which utilize the transmission and/or transference of voice, sound, vision and digital for commercial, education, security and entertainment purposes for the following:
 TV monitoring and surveillance, background-foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms and low voltage master clock systems.

A. Communication systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems

- SCADA (Supervisory control/data acquisition
- PCM (Pulse code modulation)
- Inventory control systems
- Digital data systems
- Broadband & baseband and carriers
- Point of sale systems
- VSAT data systems
- Data communication systems
- RF and remote control systems

Fiber optic data systems

B. Sound and Voice Transmission/Transference Systems

Background-Foreground Music
Intercom and Telephone Interconnect Systems
Sound and Musical Entertainment Systems
Nurse Call Systems
Radio Page Systems
School Intercom and Sound Systems
Burglar Alarm Systems
Low-Voltage Master Clock Systems
Multi-Media/Multiplex Systems
Telephone Systems
RF Systems and Antennas and Wave Guide

C. *Fire Alarm Systems-installation, wire pulling and testing.

D. Television and Video Systems

Television Monitoring and Surveillance Systems
Video Security Systems
Video Entertainment Systems
Video Educational Systems

Microwave Transmission Systems
CATV and CCTV

E. Security Systems

Perimeter Security Systems
Vibration Sensor Systems
Sonar/Infrared Monitoring Equipment
Access Control Systems
Card Access Systems

*Fire Alarm Systems

1. Fire Alarms-In Raceways
 - a. Wire and cable pulling, in raceways, performed at the current electrician wage rate and fringe benefits.
 - b. Installation and termination of devices, panels, startup, testing and programming performed by the technician.
2. Fire Alarms-Open Wire Systems
 - a. Open wire systems installed by the technician.

ELEC0112B 06/01/2002

	Rates	
Fringes		
KITTITAS COUNTY		
ELECTRICIANS	28.75	
3%+9.63		
CABLE SPLICERS	30.19	
3%+9.63		

ELEC0112G 06/01/2000

	Rates	
Fringes		
KITTTITAS COUNTY		
COMMUNICATION & SOUND		
TECHNICIANS	19.00	4.80

SCOPE OF WORK

The work covered shall include the installation, testing, service and maintenance, of the following systems that utilize the transmission and/or transference of voice, sound, vision and digital for commercial, education, security and entertainment purposes for TV monitoring and surveillance, background foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms and low voltage master clock systems.

A. Communication systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems

SCADA (Supervisory control/data acquisition

PCM (Pulse code modulation)

Inventory control systems

Digital data systems

Broadband & baseband and carriers

Point of sale systems

VSAT data systems

Data communication systems
RF and remote control systems
Fiber optic data systems

B. Sound and Voice Transmission/Transference Systems

Background-Foreground Music
Intercom and Telephone Interconnect Systems
Sound and Musical Entertainment Systems
Nurse Call Systems
Radio Page Systems
School Intercom and Sound Systems
Burglar Alarm Systems
Low-Voltage Master Clock Systems
Multi-Media/Multiplex Systems
Telephone Systems
RF Systems and Antennas and Wave Guide

C. *Fire Alarm Systems-installation, wire pulling and testing.

D. Television and Video Systems

Television Monitoring and Surveillance Systems
Video Security Systems
Video Entertainment Systems
Video Educational Systems
Microwave Transmission Systems
CATV and CCTV

E. Security Systems

Perimeter Security Systems
Vibration Sensor Systems
Sonar/Infrared Monitoring Equipment
Access Control Systems
Card Access Systems

*Fire Alarm Systems

1. Fire Alarms-In Raceways
 - a. Wire and cable pulling, in raceways, performed at the current electrician wage rate and fringe benefits.
 - b. Installation and termination of devices, panels, startup, testing and programing performed by the technician.
2. Fire Alarms-Open Wire Systems
 - a. Open wire systems installed by the technician.

ELEC0191A 12/01/2002

Rates

Fringes

CHELAN COUNTY

ELECTRICIANS

26.66

3%+9.28

CABLE SPLICERS

29.33

3%+9.28

ELEC0191E 06/01/2002

Rates

Fringes

CHELAN AND SNOHOMISH COUNTIES

SOUND AND COMMUNICATIONS

TECHNICIANS

21.50

4.84

SCOPE OF WORK

The work covered shall include the installation, testing, service and maintenance, of the following systems that utilize the transmission and/or transference of voice, sound, vision and digital for commercial, education, security and entertainment purposes for TV monitoring and surveillance, background foreground music, intercom and telephone interconnect, inventory control systems, microwave transmission, multi-media, multiplex, nurse call system, radio page, school intercom and sound, burglar alarms and low voltage master clock systems.

A. Communication systems that transmit or receive information and/or control systems that are intrinsic to the above listed systems

SCADA (Supervisory control/data acquisition

PCM (Pulse code modulation)

Inventory control systems

Digital data systems

Broadband & baseband and carriers

Point of sale systems

VSAT data systems

Data communication systems
RF and remote control systems
Fiber optic data systems

B. Sound and Voice Transmission/Transference Systems

Background-Foreground Music
Intercom and Telephone Interconnect Systems
Sound and Musical Entertainment Systems
Nurse Call Systems
Radio Page Systems
School Intercom and Sound Systems
Burglar Alarm Systems
Low-Voltage Master Clock Systems
Multi-Media/Multiplex Systems
Telephone Systems
RF Systems and Antennas and Wave Guide

C. *Fire Alarm Systems-installation, wire pulling and testing.

D. Television and Video Systems

Television Monitoring and Surveillance Systems
Video Security Systems
Video Entertainment Systems
Video Educational Systems
Microwave Transmission Systems

CATV and CCTV

E. Security Systems

Perimeter Security Systems
Vibration Sensor Systems
Sonar/Infrared Monitoring Equipment
Access Control Systems
Card Access Systems

*Fire Alarm Systems

1. Fire Alarms-In Raceways

- a. Wire and cable pulling, in raceways, performed at the current electrician wage rate and fringe benefits.
- b. Installation and termination of devices, panels, startup, testing and programming performed by the technician.

2. Fire Alarms-Open Wire Systems

- a. Open wire systems installed by the technician.

ELEC0191L 08/31/2000

Rates

Fringes

SNOHOMISH COUNTY

ELECTRICIANS

28.21

3%+7.23

CABLE SPLICERS

31.03

3%+7.23

ELEV0019B 07/01/2002

Rates

Fringes

CHELAM, CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP,
KITITITAS, LEWIS, MASON, PIERCE, SNOHOMISH AND THURSTON
COUNTIES

ELEVATOR MECHANICS

32.565

7.455+a

FOOTNOTE a: Vacation Pay: 8% with 5 or more years of
service, 6%
for 6 months to 5 years service. Paid Holidays: New Years
Day,
Memorial Day, Independence Day, Labor Day, Thanksgiving Day
and
Friday after, and Christmas Day.

ELEV0023B 04/01/2002

Rates

Fringes

PACIFIC COUNTY

ELEVATOR MECHANIC

32.735

7.455+a

FOOTNOTE a: Vacation Pay: 8% with 5 or more years of
service, 6%
for 6 months to 5 years service. Paid Holidays: Memorial
Day,
Independence Day, Labor Day, Thanksgiving Day and Friday
after,
and Christmas Day, and New Years Day.

ENGI0302B 06/01/2002

Rates

Fringes

CHELAN (WEST OF THE 120TH MERIDIAN), CLALLAM, GRAYS HARBOR,

JEFFERSON, KING, KITSAP, KITTITAS, MASON AND SNOHOMISH
COUNTIES

ON PROJECTS DESCRIBED IN FOOTNOTE A BELOW, THE RATE FOR
EACH

GROUP SHALL BE 95% OF THE BASE RATE PLUS FULL FRINGE
BENEFITS.

ON ALL OTHER WORK, THE FOLLOWING RATES APPLY.

POWER EQUIPMENT OPERATORS:

Zone 1 (0-25 radius miles):

GROUP 1AAA	31.14	8.40
GROUP 1AA	30.64	8.40
GROUP 1A	30.14	8.40
GROUP 1	29.64	8.40
GROUP 2	29.20	8.40
GROUP 3	28.84	8.40
GROUP 4	26.74	8.40

Zone Differential (Add to Zone 1 rates):

Zone 2 (26-45 radius miles) - \$.70

Zone 3 (Over 45 radius miles) - \$1.00

BASEPOINTS: Aberdeen, Bellingham, Bremerton, Everett,
Kent, Mount Vernon, Port Angeles, Port Townsend, Seattle,
Shelton, Wenatchee, Yakima

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1AAA - Cranes-over 300 tons, or 300 ft of boom
(including
jib with attachments)

GROUP 1AA - Cranes 200 to 300 tons, or 250 ft of boom
(including
jib with attachments); Tower crane over 175 ft in height,
base to
boom

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 100 tons and over; Tower crane up to 175 ft in height base to boom; Loaders-overhead, 8 yards and over; Shovels, excavator, backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes 45 tons thru 99 tons, under 150 ft of boom (including jib with attachments); Crane-overhead, bridge type, 45 tons thru 99 tons; Derricks on building work; Excavator, shovel, backhoes over 3 yards and under 6 yards; Hard tail end dump articulating off-road equipment 45 yards and over; Loader-overhead 6 yards to, but not including 8 yards; Mucking machine, mole, tunnel, drill and/or shield; Quad 9, HD 41, D-10; Remote control operator on rubber tired earth moving equipment; Rollagon; Scrapers-self propelled 45 yards and over; Slipform pavers; Transporters, all truck or track type

GROUP 2 - Barrier machine (zipper); Batch Plant Operator-Concrete; Bump Cutter; Cranes, 20 tons thru 44 tons with attachments; Crane-overhead, bridge type-20 tons through 44 tons; Chipper; Concrete Pump-truck mount with boom attachment; Crusher; Deck Engineer/Deck Winches (power); Drilling machine; Excavator, shovel, backhoe-3 yards and under; Finishing Machine, Bidwell, Gamaco and similar equipment; Guardrail punch; Horizontal/directional drill operator; Loaders-overhead under 6 yards; Loaders-plant feed; Locomotives-all; Mechanics-all; Mixers-asphalt plant; Motor patrol graders-finishing; Piledriver (other than crane mount); Roto-mill, roto-grinder; Screedman,

spreader, topside operator-Blaw Knox, Cedar Rapids, Jaeger, Caterpillar, Barber Green; Scraper-self propelled, hard tail end
dump, articulating off-road equipment-under 45 yards;
Subgrade
trimmer; Tractors, backhoes-over 75 hp; Transfer material service
machine-shuttle buggy, blaw knox-roadtec; Truck crane
oiler/driver-100 tons and over; Truck Mount portable conveyor;
Yo Yo Pay dozer

GROUP 3 - Conveyors; Cranes-thru 19 tons with attachments; A-frame crane over 10 tons; Drill oilers-auger type, truck or crane mount; Dozers-D-9 and under; Forklift-3000 lbs. and over
with attachments; Horizontal/directional drill locator; Outside
hoists-(elevators and manlifts), air tuggers, strato tower bucket
elevators; Hydralifts/boom trucks over 10 tons; Loader-elevating
type, belt; Motor patrol grader-nonfinishing; Plant oiler-asphalt, crusher; Pumps-concrete; Roller, plant mix or multi-lift
materials; Saws-concrete; Scrapers-concrete and carry-all; Service engineer-equipment; Trenching machines; Truck Crane
Oiler/Driver under 100 tons; Tractors, backhoe 75 hp and under

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete finish machine-laser screed; Cranes-A frame-10 tons and under; Elevator and Manlift-permanent or shaft type; Gradechecker, Stakehop; Forklifts under 3000 lbs. with attachments; Hydralifts/boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator;
Pavement breaker; Posthole digger, mechanical; Power plant; Pumps, water; Rigger and Bellman; Roller-other than plant mix;
Wheel Tractors, farmall type; Shotcrete/gunite equipment operator

FOOTNOTE A- Reduced rates may be paid on the following:

1. Projects involving work on structures such as buildings and bridges whose total value is less than \$1.5 million excluding mechanical, electrical, and utility portions of the contract.

2. Projects of less than \$1 million where no building is involved. Surfacing and paving included, but utilities excluded.

3. Marine projects (docks, wharfs, etc.) less than \$150,000.

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be eligible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.
H-1 Base wage rate when on a hazardous waste site when not

outfitted with protective clothing
H-2 Class "C" Suit - Base wage rate plus \$.25 per hour.
H-3 Class "B" Suit - Base wage rate plus \$.50 per hour.
H-4 Class "A" Suit - Base wage rate plus \$.75 per hour.

ENGI0370I 06/01/2002

Rates

Fringes
CHELAN (EAST OF THE 120TH MERIDIAN) COUNTY

ZONE 1:

POWER EQUIPMENT OPERATORS:

GROUP 1A	20.44	6.52
GROUP 1	20.99	6.52
GROUP 2	21.31	6.52
GROUP 3	21.92	6.52
GROUP 4	22.08	6.52
GROUP 5	22.24	6.52
GROUP 6	22.52	6.52

GROUP 7	22.79	6.52
GROUP 8	23.89	6.52

ZONE DIFFERENTIAL (Add to Zone 1
rate): Zone 2 - \$2.00

Zone 1: Within 45 mile radius of Spokane, Moses Lake,
Pasco,

Washington; Lewiston, Idaho

Zone 2: Outside 45 mile radius of Spokane, Moses Lake,
Pasco,

Washington; Lewiston, Idaho

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1A: Boat Operator; Crush Feeder; Oiler; Steam
Cleaner

GROUP 1: Bit Grinders; Bolt Threading Machine;
Compressors
(under 2000 CFM, gas, diesel, or electric power); Deck
Hand;
Drillers Helper (assist driller in making drill rod
connections,
service drill engine and air compressor, repair drill rig
and
drill tools; drive drill support truck to and on the job
site,
remove drill cuttings from around bore hole and inspect
drill rig
while in operation); Fireman & Heat Tender; Grade Checker;
Hydro-
seeder, Mulcher, Nozzleman; Oiler Driver, & Cable Tender,
Mucking
Machine; Pumpman; Rollers, all types on subgrade, including
seal
and chip coatings (farm type, Case, John Deere & similar,
or
Compacting Vibrator), except when pulled by Dozer with
operable
blade; Welding Machine

GROUP 2: A-frame Truck (single drum); Assistant
Refrigeration
Plant (under 1000 ton); Assistant Plant Operator, Fireman
or
Pugmixer (asphalt); Bagley or Stationary Scraper; Belt
Finishing

Machine; Blower Operator (cement); Cement Hog; Compressor (2000 CFM or over, 2 or more, gas diesel or electric power); Concrete Saw (multiple cut); Distributor Leverman; Ditch Witch or similar; Elevator Hoisting Materials; Dope Pots (power agitated); Fork Lift or Lumber Stacker, hydra-lift & similar; Gin Trucks (pipeline); Hoist, single drum; Loaders (bucket elevators and conveyors); Longitudinal Float; Mixer (portable-concrete); Pavement Breaker, Hydra-Hammer & similar; Power Broom; Railroad Ballast Regulation Operator (self-propelled); Railroad Power Tamper Operator (self-propelled); Railroad Tamper Jack Operator (self-propelled); Spray Curing Machine (concrete); Spreader Box (self-propelled); Straddle Buggy (Ross & similar on construction job only); Tractor (Farm type R/T with attachment, except Backhoe); Tugger Operator

GROUP 3: A-frame Truck (2 or more drums); Assistant Refrigeration Plant & Chiller Operator (over 1000 ton); Backfillers (Cleveland & similar); Batch Plant & Wet Mix Operator, single unit (concrete); Belt-Crete Conveyors with power pack or similar; Belt Loader (Kocal or similar); Bending Machine; Bob Cat; Boring Machine (earth); Boring Machine (rock under 8" bit) (Quarry Master, Joy or similar); Bump Cutter (Wayne, Saginaw or similar); Canal Lining Machine (concrete); Chipper (without crane); Cleaning & Doping Machine (pipeline); Deck Engineer; Elevating Belt-type Loader (Euclid, Barber Green & similar); Elevating Grader-type Loader (Dumor, Adams or similar); Generator Plant Engineers (diesel or electric); Gunnite Combination Mixer &

Compressor; Locomotive Engineer; Mixermobile; Mucking Machine;
Posthole Auger or Punch; Pump (grout or jet); Soil Stabilizer (P
& H or similar); Spreader Machine; Tractor (to D-6 or equivalent)
and Traxcavator; Traverse Finish Machine; Turnhead Operator

GROUP 4: Concrete Pumps (squeeze-crete, flow-crete, pump-crete,
Whitman & similar); Curb Extruder (asphalt or concrete); Drills
(churn, core, calyx or diamond)(Operate drilling machine, drive
or transport drill rig to and on job site and weld well casing);
Equipment Serviceman, Greaser & Oiler; Hoist (2 or more drums or
Tower Hoist); Loaders (overhead & front-end, under 4 yds. R/T);
Refrigeration Plant Engineer (under 1000 ton); Rubber-tired Skidders (R/T with or without attachments); Surface Heater &
Planer Machine; Trenching Machines (under 7 ft. depth capacity);
Turnhead (with re-screening); Vacuum Drill (reverse circulation
drill under 8" bit)

GROUP 5: Backhoe (under 45,000 gw); Backhoe and Hoe Ram (under 3/4 yd.); Carrydeck & boom truck (under 25 tons); Cranes
(25 tons & under), all attachments including clamshell, dragline);
Derricks & Stifflegs (under 65 tons); Drilling Equipment (8" bit
& over) (Robbins, reverse circulation & similar)(operates drill
machine, drive or transport drill rig to and on job site and weld
well casing); Hoe Ram; Piledriving Engineers; Paving (dual drum);
Railroad Track Liner Operator(self-propelled); Refrigeration
Plant Engineer (1000 tons & over); Signalman (Whirleys, Highline
Hammerheads or similar)

GROUP 6: Asphalt Plant Operator; Automatic Subgrader (Ditches & Trimmers) (Autograde, ABC, R.A. Hansen & similar on grade wire); Backhoe (45,000 gw and over to 110,000 gw); Backhoes & Hoe Ram (3/4 yd. to 3 yd.); Batch Plant (over 4 units); Batch & Wet Mix Operator (multiple units, 2 & incl. 4); Blade Operator (Motor Patrol & Attachments, Athey & Huber); Boom Cats (side); Cableway

Controller (dispatcher); Clamshell Operator (under 3 yds.); Compactor (self-propelled with blade); Concrete Pump Boom Truck; Concrete Slip Form Paver; Cranes (over 25 tons including 45 tons), all attachments including clamshell, dragline; Crusher, Grizzle & Screening Plant Operator; Dozer, 834 R/T & similar; Draglines (under 3 yds.); Drill Doctor; H.D.Mechanic; H.D. Welder; Loader Operator (front-end & overhead, 4 yds. incl. 8 yds.), Multiple Dozer Units with single blade; Paving Machine (asphalt and concrete); Quad-Track or similar equipment; Rollerman (finishing asphalt pavement); Roto Mill (pavement grinder); Scrapers, all rubber-tired; Screed Operator; Shovel (under 3 yds.); Tractors (D-6 & equivalent & over); Trenching Machines (7 ft. depth & over); Tug Boat Operator; Vactor Guzzler, super sucker

GROUP 7: Backhoe (over 110,000 gw); Backhoes & Hoe Ram (3 yds. & over); Blade (finish & bluetop), Automatic, CMI, ABC, Finish Athey & Huber & similar when used as automatic; Cableway Operators; Clamshell Operator (3 yds. & over); Cranes (over 45 tons to but not including 85 tons), all attachments including clamshell and dragline; Derricks & Stifflegs (65 tons & over); Draglines (3 yds. & over); Elevating Belt (Holland type); Heavy Equipment Robotics Operator; Loader (360 degrees revolving Koehring Scooper or similar); Loaders (overhead &

front-end, over 8 yds. to 10 yds.); Rubber-tired Scrapers (multiple engine with three or more scrapers); Shovels (3 yds. & over); Ultra High Pressure Waterjet Cutting Tool System Operator (30,000 psi); Vacuum Blasting Machine Operator; Whirleys & Hammerheads, ALL

GROUP 8: Cranes (85 tons and over, and all climbing, overhead, rail and tower); Loaders (overhead and front-end, 10 yards and over); Helicopter Pilot

BOOM PAY: (All Cranes, Including Tower)

180' to 250' \$.30 over scale

Over 250' \$.60 over scale

NOTE: In computing the length of the boom on Tower Cranes, they

shall be measured from the base of the tower to the point of the boom.

HAZMAT: Anyone working on HAZMAT jobs, working with supplied air

shall receive \$1.00 an hour above classification.

ENGI0612B 06/01/2002

Rates

Fringes

LEWIS, PIERCE, PACIFIC (portion lying north of a parallel line

extending west from the northern boundary of Wahkaikum County to

the sea) AND THURSTON COUNTIES

ON PROJECTS DESCRIBED IN FOOTNOTE A BELOW, THE RATE FOR EACH

GROUP SHALL BE 90% OF THE BASE RATE PLUS FULL FRINGE BENEFITS.

ON ALL OTHER WORK, THE FOLLOWING RATES APPLY.

POWER EQUIPMENT OPERATORS:

Zone 1 (0-25 radius miles):

GROUP 1AAA

31.14

8.40

GROUP 1AA	30.64	8.40
GROUP 1A	30.14	8.40
GROUP 1	29.64	8.40
GROUP 2	29.20	8.40
GROUP 3	28.84	8.40
GROUP 4	26.74	8.40

Zone Differential (Add to Zone 1 rates):

Zone 2 (26-45 radius miles) = \$.70

Zone 3 (Over 45 radius miles) - \$1.00

BASEPOINTS: CENTRALIA, OLYMPIA, TACOMA

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1 AAA - Cranes-over 300 tons or 300 ft of boom
(including
jib with attachments)

GROUP 1AA - Cranes- 200 tons to 300 tons, or 250 ft of boom
(including jib with attachments; Tower crane over 175 ft in
height, base to boom)

GROUP 1A - Cranes, 100 tons thru 199 tons, or 150 ft of
boom
(including jib with attachments); Crane-overhead, bridge
type,
100 tons and over; Tower crane up to 175 ft in height base
to
boom; Loaders-overhead, 8 yards and over; Shovels,
excavator,
backhoes-6 yards and over with attachments

GROUP 1 - Cableway; Cranes 45 tons thru 99 tons under 150
ft of
boom (including jib with attachments); Crane-overhead,
bridge
type, 45 tons thru 99 tons; Derricks on building work;
Excavator,
shovel, backhoes over 3 yards and under 6 yards; Hard tail
end
dump articulating off-road equipment 45 yards and over;
Loader-
overhead, 6 yards to, but not including, 8 yards; Mucking
machine, mole, tunnel, drill and/or shield; Quad 9 HD 41,
D-10;
Remote control operator on rubber tired earth moving
equipment;

Rollagon; Scrapers-self-propelled 45 yards and over;
Slipform
pavers; Transporters, all track or truck type

GROUP 2 - Barrier machine (zipper); Batch Plant Operator-
concrete; Bump Cutter; Cranes, 20 tons thru 44 tons with
attachments; Crane-Overhead, bridge type, 20 tons through
44
tons; Chipper; Concrete pump-truck mount with boom
attachment;
Crusher; Deck engineer/deck winches (power); Drilling
machine;
Excavator, shovel, backhoe-3 yards and under; Finishing
machine,
Bidwell, Gamaco and similar equipment; Guardrail punch;
Loaders,
overhead under 6 yards; Loaders-plant feed; Locomotives-
all;
Mechanics- all; Mixers, asphalt plant; Motor patrol
graders,
finishing; Piledriver (other than crane mount); Roto-mill,
roto-
grinder; Screedman, spreader, topside operator-Blaw Knox,
Cedar
Rapids, Jaeger, Caterpillar, Barbar Green; Scraper-self-
propelled, hard tail end dump, articulating off-road
equipment-
under 45 yards; Subgrader trimmer; Tractors, backhoe over
75

hp; Transfer material service machine-shuttle buggy, Blaw
Knox-
Roadtec; Truck Crane oiler/driver-100 tons and over; Truck
Mount
Portable Conveyor; Yo Yo pay

GROUP 3 - Conveyors; Cranes through 19 tons with
attachments;
Crane-A-frame over 10 tons; Drill oilers-auger type, truck
or
crane mount; Dozer-D-9 and under; Forklift-3000 lbs. and
over
with attachments; Horizontal/directional drill locator;
Outside
Hoists-(elevators and manlifts), air tuggers, strato tower
bucket
elevators; Hydralifts/boom trucks over 10 tons; Loaders-
elevating

type, belt; Motor patrol grader-nonfinishing; Plant oiler-asphalt, crusher; Pump-Concrete; Roller, plant mix or multi-lfit materials; Saws-concrete; Scrapers, concrete and carry all; Service engineers-equipment; Trenching machines; Truck crane oiler/driver under 100 tons; Tractors, backhoe under 75 hp

GROUP 4 - Assistant Engineer; Bobcat; Brooms; Compressor; Concrete Finish Machine-laser screed; Cranes A-frame 10 tons and under; Elevator and manlift (permanent and shaft type); Forklifts-under 3000 lbs. with attachments; Gradechecker, stakeop; Hydralifts/boom trucks, 10 tons and under; Oil distributors, blower distribution and mulch seeding operator; Pavement breaker; Posthole digger-mechanical; Power plant; Pumps-water; Rigger and Bellman; Roller-other than plant mix; Wheel Tractors, farmall type; Shotcrete/gunite equipment operator

FOOTNOTE A- Reduced rates may be paid on the following:

1. Projects involving work on structures such as buildings and bridges whose total value is less than \$1.5 million excluding mechanical, electrical, and utility portions of the contract.
2. Projects of less than \$1 million where no building is involved. Surfacing and paving included, but utilities excluded.
3. Marine projects (docks, wharfs, etc.) less than \$150,000.

HANDLING OF HAZARDOUS WASTE MATERIALS: Personnel in all craft classifications subject to working inside a federally designated hazardous perimeter shall be eligible for compensation in accordance with the following group schedule relative to the level of hazardous waste as outlined in the specific hazardous waste project site safety plan.

H-1 Base wage rate when on a hazardous waste site when not
 outfitted with protective clothing
 H-2 Class "C" Suit - Base wage rate plus \$.25 per hour.
 H-3 Class "B" Suit - Base wage rate plus \$.50 per hour.
 H-4 Class "A" Suit - Base wage rate plus \$.75 per hour.

ENGI0701H 01/01/2003

Rates

Fringes

PACIFIC (remaining portion) COUNTY

POWER EQUIPMENT OPERATORS (See Footnote A)

ZONE 1:

GROUP 1	29.30	8.95
GROUP 1A	30.77	8.95
GROUP 1B	32.23	8.95
GROUP 2	28.07	8.95
GROUP 3	27.31	8.95
GROUP 4	26.79	8.95
GROUP 5	26.19	8.95
GROUP 6	23.84	8.95

Zone Differential (add to Zone 1 rates):

Zone 2 - \$1.50

Zone 3 - 3.00

For the following metropolitan counties: MULTNOMAH;
 CLACKAMAS;
 MARION; WASHINGTON; YAMHILL; AND COLUMBIA; CLARK; AND
 COWLITZ
 COUNTY, WASHINGTON WITH MODIFICATIONS AS INDICATED:

All jobs or projects located in Multnomah, Clackamas and
 Marion
 Counties, West of the western boundary of Mt. Hood National
 Forest and West of Mile Post 30 on Interstate 84 and West
 of Mile
 Post 30 on State Highway 26 and West of Mile Post 30 on
 Highway
 22 and all jobs or projects located in Yamhill County,
 Washington
 County and Columbia County and all jobs or porjects located
 in
 Clark & Cowlitz County, Washington except that portion of
 Cowlitz

County in the Mt. St. Helens "Blast Zone" shall receive Zone I pay for all classifications.

All jobs or projects located in the area outside the identified boundary above, but less than 50 miles from the Portland City Hall shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the Portland City Hall, but outside the identified border above, shall receive Zone III pay for all classifications.

For the following cities: ALBANY; BEND; COOS BAY; EUGENE; GRANTS PASS; KLAMATH FALLS; MEDFORD; ROSEBURG

All jobs or projects located within 30 miles of the respective city hall of the above mentioned cities shall receive Zone I pay for all classifications.

All jobs or projects located more than 30 miles and less than 50 miles from the respective city hall of the above mentioned cities shall receive Zone II pay for all classifications.

All jobs or projects located more than 50 miles from the respective city hall of the above mentioned cities shall receive Zone III pay for all classifications.

POWER EQUIPMENT OPERATORS CLASSIFICATIONS

GROUP 1: CONCRETE: Batch Plant and/or Wet Mix Operator, three

units or more; CRANE: Helicopter Operator, when used in erecting work; Whirley Operator, 90 ton and over; LATTICE BOOM CRANE: Operator 200 tons through 299 tons, and/or over 200 feet boom;

HYDRAULIC CRANE: Hydraulic Crane Operator 90 tons through 199 tons with luffing or tower attachments; FLOATING EQUIPMENT: Floating Crane, 150 ton but less than 250 ton

GROUP 1A: HYDRAULIC CRANE: Hydraulic Operator, 200 tons and over (with luffing or tower attachment); LATTICE BOOM CRANE: Operator, 200 tons through 299 tons, with over 200 feet boom; FLOATING EQUIPMENT: Floating Crane 250 ton and over

GROUP 1B: LATTICE BOOM CRANE: Operator, 300 tons through 399 tons with over 200 feet boom; Operator 400 tons and over; FLOATING EQUIPMENT: Floating Crane 350 ton and over

GROUP 2: ASPHALT: Asphalt Plant Operator (any type); Roto Mill, pavement profiler, operator, 6 foot lateral cut and over; BLADE: Auto Grader or "Trimmer" (Grade Checker required); Blade Operator, Robotic; BULLDOZERS: Bulldozer operator over 120,000 lbs and above; Bulldozer operator, twin engine; Bulldozer Operator, tandem, quadnine, D10, D11, and similar type; Bulldozere Robotic Equipment (any type; CONCRETE: Batch Plant and/or Wet Mix Operator, one and two drum; Automatic Concrete Slip Form Paver Operator; Concrete Canal Line Operator; Concrete Profiler, Diamond Head; CRANE: Cableway Operator, 25 tons and over; HYDRAULIC CRANE: Hydraulic crane operator 90 tons through 199 tons (with luffing or tower attachment); TOWER/WHIRLEY OPERATOR: Tower Crane Operator; Whirley Operator, under 90 tons; LATTICE BOOM CRANE: 90 through 199 tons and/or 150 to 200 feet boom; CRUSHER: Crusher Plant Operator; FLOATING EQUIPMENT: Floating Clamshell, etc.operator, 3 cu. yds. and over; Floating Crane (derrick barge) Operator, 30 tons but less than 150 tons; LOADERS: Loader operator, 120,000 lbs. and above; REMOTE CONTROL: Remote

controlled earth-moving equipment; RUBBER-TIRED SCRAPERS: Rubber-tired scraper operator, with tandem scrapers, multi-engine; SHOVEL, DRAGLINE, CLAMSHELL, SKOOPER OPERATOR: Shovel, Dragline, Clamshell, operator 5 cu. yds and over; TRENCHING MACHINE: Wheel Excavator, under 750 cu. yds. per hour (Grade Oiler required); Canal Trimmer (Grade Oiler required); Wheel Excavator, over 750 cu. yds. per hour; Band Wagon (in conjunction with wheel excavator); UNDERWATER EQUIPMENT: Underwater Equipment Operator, remote or otherwise; HYDRAULIC HOES-EXCAVATOR: Excavator over 130,000 lbs.

GROUP 3: BULLDOZERS: Bulldozer operator, over 70,000 lbs. up to and including 120,000 lbs.; HYDRAULIC CRANE: Hydraulic crane operator, 50 tons through 89 tons (with luffing or tower attachment); LATTICE BOOM CRANES: Lattice Boom Crane-50 through 89 tons (and less than 150 feet boom); FORKLIFT: Rock Hound Operator; HYDRAULIC HOES-EXCAVATOR: excavator over 80,000 lbs. through 130,000 lbs.; LOADERS: Loader operator 60,000 and less than 120,000; RUBBER-TIRED SCRAPERS: Scraper Operator, with tandem scrapers; Self-loading, paddle wheel, auger type, finish and/or 2 or more units; SHOVEL, DRAGLINE, CLAMSHELL, SKOOPER OPERATOR: Shovel, Dragline, Clamshell operators 3 cu. yds. but less than 5 cu yds.

GROUP 4: ASPHALT: Screed Operator; Asphalt Paver operator (screeman required); BLADE: Blade operator; Blade operator, finish; Blade operator, externally controlled by electronic, mechanical hydraulic means; Blade operator, multi-engine; BULLDOZERS: Bulldozer Operator over 20,000 lbs and more than 100 horse up to 70,000 lbs; Drill Cat Operator; Side-boom Operator; Cable-Plow Operator (any type); CLEARING: Log Skidders;

Chippers; Incinerator; Stump Splitter (loader mounted or similar type); Stump Grinder (loader mounted or similar type; Tub Grinder; Land Clearing Machine (Track mounted forestry mowing & grinding machine); Hydro Axe (loader mounted or similar type);
 COMPACTORS SELF-PROPELLED: Compactor Operator, with blade; Compactor Operator, multi-engine; Compactor Operator, robotic;
 CONCRETE: Mixer Mobile Operator; Screed Operator; Concrete Cooling Machine Operator; Concrete Paving Road Mixer; Concrete Breaker; Reinforced Tank Banding Machine (K-17 or similar types);
 Laser Screed; CRANE: Chicago boom and similar types; Lift Slab Machine Operator; Boom type lifting device, 5 ton capacity or less; Hoist Operator, two (2) drum; Hoist Operator, three (3) or more drums; Derrick Operator, under 100 ton; Hoist Operator, stiff leg, guy derrick or similar type, 50 ton and over; Cableway Operator up to twenty (25) ton; Bridge Crane Operator, Locomotive, Gantry, Overhead; Cherry Picker or similar type crane; Carry Deck Operator; Hydraulic Crane Operator, under 50 tons; LATTICE BOOM CRANE OPERATOR: Lattice Boom Crane Operator, under 50 tons; CRUSHER: Generator Operator; Diesel-Electric Engineer; Grizzly Operator; Drill Doctor; Boring Machine Operator; Driller-Percussion, Diamond, Core, Cable, Rotary and similar type; Cat Drill (John Henry); Directional Drill Operator over 20,000 lbs pullback; FLOATING EQUIPMENT: Diesel-electric Engineer; Jack Operator, elevating barges, Barge Operator, self-unloading; Piledriver Operator (not crane type) (Deckhand required); Floating Clamshell, etc. Operator, under 3 cu. yds. (Fireman or Diesel-Electric Engineer required); Floating Crane (derrick barge) Operator, less than 30 tons; GENERATORS: Generator Operator; Diesel-electric Engineer; GUARDRAIL

EQUIPMENT: Guardrail Punch Operator (all types); Guardrail Auger Operator (all types); Combination Guardrail machines, i.e., punch auger, etc.; HEATING PLANT: Surface Heater and Planer Operator; HYDRAULIC HOES EXCAVATOR: Robotic Hydraulic backhoe operator, track and wheel type up to and including 20,000 lbs. with any or all attachments; Excavator Operator over 20,000 lbs through 80,000 lbs.; LOADERS: Belt Loaders, Kolman and Ko Cal types; Loaders Operator, front end and overhead, 25,000 lbs and less than 60,000 lbs; Elevating Grader Operator by Tractor operator, Sierra, Euclid or similar types; PILEDRIVERS: Hammer Operator; Piledriver Operator (not crane type); PIPELINE, SEWER WATER: Pipe Cleaning Machine Operator; Pipe Doping Machine Operator; Pipe Bending Machine Operator; Pipe Wrapping Machine Operator; Boring Machine Operator; Back Filling Machine Operator; REMOTE CONTROL: Concrete Cleaning Decontamination Machine Operator; Ultra High Pressure Water Jet Cutting Tool System Operator/Mechanic; Vacuum Blasting Machine Operator/mechanic; REPAIRMEN, HEAVY DUTY: Diesel

Electric Engineer (Plant or Floating; Bolt Threading Machine operator; Drill Doctor (Bit Grinder); H.D. Mechanic; Machine Tool Operator; RUBBER-TIRED SCRAPERS: Rubber-tired Scraper Operator, single engine, single scraper; Self-loading, paddle wheel, auger type under 15 cu. yds.; Rubber-tired Scraper Operator, twin engine; Rubber-tired Scraper Operator, with push-ull attachments; Self Loading, paddle wheel, auger type 15 cu. yds. and over, single engine; Water pulls, water wagons; SHOVEL,

DRAGLINE, CLAMSHELL, SKOOPER OPERATOR: Diesel Electric Engineer;
Stationary Drag Scraper Operator; Shovel, Dragline, Clamshell,
Operator under 3 cu yds.; Grade-all Operator; SURFACE (BASE)
MATERIAL: Blade mounted spreaders, Ulrich and similar types;
TRACTOR-RUBBERED TIRED: Tractor operator, rubber-tired, over 50
hp flywheel; Tractor operator, with boom attachment; Rubber-tired
dozers and pushers (Michigan, Cat, Hough type); Skip Loader, Drag
Box; TRENCHING MACHINE: Trenching Machine operator, digging
capacity over 3 ft depth; Back filling machine operator;
TUNNEL:
Mucking machine operator

GROUP 5: ASPHALT: Extrusion Machine Operator; Roller Operator
(any asphalt mix); Asphalt Burner and Reconditioner Operator (any
type); Roto-Mill, pavement profiler, ground man;
BULLDOZERS:
Bulldozer operator, 20,000 lbs. or less or 100 horse or less;
COMPRESSORS: Compressor Operator (any power), over 1,250 cu. ft.
total capacity; COMPACTORS: Compactor Operator, including vibratory;
Wagner Pactor Operator or similar type (without blade); CONCRETE: Combination mixer and Compressor
Operator,
gunite work; Concrete Batch Plant Quality Control Operator; Beltcrete Operator; Pumpcrete Operator (any type); Pavement
Grinder and/or Grooving Machine Operator (riding type); Cement
Pump Operator, Fuller-Kenyon and similar; Concrete Pump Operator;
Grouting Machine Operator; Concrete mixer operator, single drum,
under (5) bag capacity; Cast in place pipe laying machine; maginnis Internal Full slab vibrator operator; Concrete
finishing
mahine operator, Clary, Johnson, Bidwell, Burgess Bridge deck or
similar type; Curb Machine Operator, mechanical
Berm, Curb and/or Curb and Gutter; Concrete Joint Machine

Operator; Concrete Planer Operator; Tower Mobile Operator;
 Power
 Jumbo Operator setting slip forms in tunnels; Slip Form
 Pumps,
 power driven hydraulic lifting device for concrete forms;
 Concrete Paving Machine Operator; Concrete Finishing
 Machine
 Operator; Concrete Spreader Operator; CRANE: Helicopter
 Hoist
 Operator; Hoist Operator, single drum; Elevator Operator;
 A-frame
 Truck Operator, Double drum; Boom Truck Operator; HYDRAULIC
 CRANE
 OPERATOR: Hydraulic Boom Truck, Pittman; DRILLING: Churn
 Drill
 and Earth Boring Machine Operator; Vacuum Truck;
 Directional
 Drill Operator over 20,000 lbs pullback; FLOATING
 EQUIPMENT:
 Fireman; FORKLIFT: Fork Lift, over 10 ton and/or robotic;
 HYDRAULIC HOES EXCAVATORS: Hydraulic Backhoe Operator,
 wheel type
 (Ford, John Deere, Case type); Hydraulic Backhoe Operator
 track
 type up to and including 20,000 lbs.; LOADERS: Loaders,
 rubber-
 tired type, less than 25,000 lbs; Elevating Grader
 Operator,
 Tractor Towed requiring Operator or Grader; Elevating
 loader
 operator, Athey and similar types; OILERS: Service oiler
 (Greaser); PIPELINE-SEWER WATER: Hydra hammer or simialr
 types;
 Pavement Breaker Operator; PUMPS: Pump Operator, more than
 5 (any

 size); Pot Rammer Operator; RAILROAD EQUIPMENT: Locomotive
 Operator, under 40 tons; Ballast Regulator Operator;
 Ballast
 Tamper Multi-Purpose Operator; Track Liner Operator; Tie
 Spacer
 Operator; Shuttle Car Operator; Locomotive Operator, 40
 tons and
 over; MATERIAL HAULRS: Cat wagon DJB's Volvo similar types;
 Conveyored material hauler; SURFACING (BASE) MATERIAL: Rock
 Spreaders, self-propelled; Pulva-mixer or similar types;
 Chiip

Spreading machine operator; Lime spreading operator,
 construction
 job siter; SWEEPERS: Sweeper operator (Wayne type) self-
 propelled
 construction job site; TRACTOR-RUBBER TIRED: Tractor
 operator,
 rubber-tired, 50 hp flywheel and under; Trenching machine
 operator, maximum digging capacity 3 ft depth; TUNNEL:
 Dinkey
 GROUP 6: ASPHALT: Plant Oiler; Plant Fireman; Pugmill
 Operator (any type); Truck mounted asphalt spreader, with
 screed;
 COMPRESSORS: Compressor Operator (any power), under 1,250
 cu. ft.
 total capacity; CONCRETE: Plant Oiler, Assistant Conveyor
 Operator; Conveyor Operator; Mixer Box Operator (C.T.B.,
 dry
 batch, etc.); Cement Hog Operator; Concrete Saw Operator;
 Concrete Curing Machine Operator (riding type); Wire Mat or
 Brooming Machine Operator; CRANE: Oiler; Fireman, all
 equipment;
 Truck Crane Oiler Driver; A-frame Truck Operator, single
 drum; Tugger or Coffin Type Hoist Operator; CRUSHER:
 Crusher
 Oiler; Crusher Feeder; CRUSHER: Crusher oiler; Crusher
 feeder; DRILLING: Drill Tender; Auger Oiler; FLOATING
 EQUIPMENT: Deckhand; Boatman; FORKLIFT: Self-propelled
 Scaffolding Operator, construction job site (excluding
 working
 platform); Fork Lift or Lumber Stacker Operator,
 construction job
 site; Ross Carrier Operator, construction job site; Lull
 Hi-Lift
 Operator or Similar Type; GUARDRAIL EQUIPMENT: Oiler; Auger
 Oiler; Oiler, combination guardrail machines; Guardrail
 Punch
 Oiler; HEATING PLANT: Temporary Heating Plant Operator;
 LOADERS:
 Bobcat, skid steer (less than 1 cu yd.); Bucket Elevator
 Loader
 Operator, BarberGreene and similar types; OILERS: Oiler;
 Guardrail Punch Oiler; Truck Crane Oiler-Driver; Auger
 Oiler;
 Grade Oiler, required to check grade; Grade Checker;
 Rigger;
 PIPELINE-SEWER WATER: Tar Pot Fireman; Tar Pot Fireman
 (power

agitated); PUMPS: Pump Operator (any power); Hydrostatic Pump Operator; RAILROAD EQUIPMENT: Brakeman; Oiler; Switchman; Motorman; Ballast Jack Tamper Operator; SHOVEL, DRAGLINE, CLAMSHELL, SKOOPER, ETC. OPERATOR: Oiler, Grade Oiler (required to check grade); Grade Checker; Fireman; SWEEPER: Broom operator, self propelled, construction job site; SURFACING (BASE) MATERIAL: Roller Operator, grading of base rock (not asphalt); Tamping Machine operator, mechanical, self-propelled; Hydrographic Seeder Machine Operator; TRENCHING MACHINE: Oiler; Grade Oiler; TUNNEL: Conveyor operator; Air filtration equipment operator

IRON0086A 07/01/2002

Rates

Fringes
 CHELAN AND KITTITAS COUNTIES

IRONWORKERS	26.72	11.80
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IRON0086C 07/01/2002

Rates

Fringes
 CALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC, PIERCE, SNOHOMISH AND THURSTON COUNTIES

IRONWORKERS	27.22	11.80
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LAB00001I 06/01/2002

Rates

Fringes
 CHELAN AND KITTITAS COUNTIES

LABORERS:

ZONE 1:

GROUP 1	14.79	6.20
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GROUP 2	17.11	6.20
GROUP 3	18.83	6.20
GROUP 4	19.31	6.20
GROUP 5	19.67	6.20

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$.70

ZONE 3 - \$1.00

BASE POINTS: CHELAN, SUNNYSIDE, WENATCHEE,
AND YAKIMA

ZONE 1 - Projects within 25 radius miles of the respective
city

hall

ZONE 2 - More than 25 but less than 45 radius miles from
the

respective city hall

ZONE 3 - More than 45 radius miles from the respective city
hall

CALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,
MASON,
PACIFIC (North of a straight line made by extending the
north
boundary of Wahkiakum County west to the Pacific Ocean),
PIERCE,
SNOHOMISH AND THURSTON COUNTIES

LABORERS:

ZONE 1:

GROUP 1	17.71	6.20
GROUP 2	20.03	6.20
GROUP 3	24.71	6.20
GROUP 4	25.19	6.20
GROUP 5	25.55	6.20

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$.70

ZONE 3 - \$1.00

BASE POINTS: BELLINGHAM, MT. VERNON, EVERETT,
SEATTLE, KENT, TACOMA, OLYMPIA,
CENTRALIA, ABERDEEN, SHELTON, PT.
TOWNSEND, PT. ANGELES, AND BREMERTON

ZONE 1 - Projects within 25 radius miles of the respective
city

hall
ZONE 2 - More than 25 but less than 45 radius miles from
the
respective city hall
ZONE 3 - More than 45 radius miles from the respective city
hall

LABORERS CLASSIFICATIONS

GROUP 1: Landscaping and Planting; Watchman; Window
Washer/Cleaner (detail clean-up, such as but not limited to
cleaning floors, ceilings, walls, windows, etc., prior to
final
acceptance by the owner)

GROUP 2: Batch Weighman; Crusher Feeder; Fence Laborer;
Flagman; Pilot Car

GROUP 3: General Laborer; Air, Gas, or Electric Vibrating
Screed; Asbestos Abatement Laborer; Ballast Regulator
Machine;
Brush Cutter; Brush Hog Feeder; Burner; Carpenter Tender;
Cement
Finisher Tender; Change House or Dry Shack; Chipping Gun
(under
30 lbs.); Choker Setter; Chuck Tender; Clean-up Laborer;
Concrete
Form Stripper; Curing Laborer; Demolition (wrecking and
moving
including charred material); Ditch Digger; Dump Person;
Fine
Graders; Firewatch; Form Setter; Gabian Basket Builders;
Grout
Machine Tender; Grinders; Guardrail Erector; Hazardous
Waste
Worker (Level C); Maintenance Person; Material Yard Person;
Pot
Tender; Rip Rap Person; Riggers; Scale Person; Sloper
Sprayer;
Signal Person; Stock Piler; Stake Hopper; Toolroom Man (at
job
site); Topper-Tailer; Track Laborer; Truck Spotter; Vinyl
Seamer

GROUP 4: Cement Dumper-Paving; Chipping Gun (over 30
lbs.);
Clary Power Spreader; Concrete Dumper/Chute Operator;
Concrete

Saw Operator; Drill Operator (hydraulic, diamond, aiartrac);
 Faller and Bucker Chain Saw; Grade Checker and Transit Person;
 Groutmen (pressure) including post tension beams; Hazardous Waste
 Worker (Level B); High Scaler; Jackhammer; Laserbeam Operator;
 Manhole Builder-Mudman; Mortarman and Hodcarrier; Nozzleman (concrete pump, green cutter when using combination of high pressure air and water on concrete and rock, sandblast, gunite, shotcrete, water blaster, vacuum blaster); Pavement Breaker; Pipe Layer and Caulker; Pipe Pot Tender; Pipe Reliner (not insert type); Pipe Wrapper; Power Jacks; Railroad Spike Puller-Power;
 Raker-Asphalt; Rivet Buster; Rodder; Sloper (over 20'); Spreader (concrete); Tamper and Similar electric, air and glas operated tool; Timber Person-sewer (lagger shorer and cribber); Track Liner Power; Tugger Operator; Vibrator; Well Point Laborer

GROUP 5: Caisson Worker; Miner; Powderman; Re-Timberman; Hazardous Waste Worker (Level A).

LAB00238I 06/01/2002

Rates

Fringes
 CHELAN COUNTY

HOD CARRIERS	21.55	5.50
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LAB00335C 06/01/2002

Rates

Fringes
 PACIFIC (South of a straight line made by extending the north
 Boundary line of Wahkiakum County west to the Pacific Ocean)

COUNTY

ZONE 1:

LABORERS:

GROUP 1	23.43	6.15
GROUP 2	23.94	6.15
GROUP 3	24.33	6.15
GROUP 4	24.66	6.15
GROUP 5	21.26	6.15
GROUP 6	19.16	6.15
GROUP 7	16.40	6.15

LABORERS CLASSIFICATIONS

GROUP 1: Asphalt Plant Laborers; Asphalt Spreaders; Batch Weighman; Broomers; Brush Burners and Cutters; Car and Truck Loaders; Carpenter Tender; Change-House Man or Dry Shack Man; Choker Setter; Clean-up Laborers; Curing-concrete; Demolition, Wrecking, and Moving Laborers; Dumpers, road oiling crew; Dumpmen (for grading crew); Elevator Feeders; Guard Rail, Median Rail, Reference Post, Guide Post, Right-of-way Marker; Fine Graders; Fire Watch; Form Strippers (not swinging stages); General Laborers; Hazardous Waste Worker; Leverman or Aggregate Spreader (Flaherty and similar types); Loading Spotters; Material Yard Man (including electrical); Pittsburgh Chipper Operator or similar types; Railroad Track Laborers; Ribbon Setters (including steel forms); Rip Rap Man (hand placed); Road Pump Tender; Sewer Laborer; Signalman; Skipman; Slopers; Spraymen; Stake Chaser; Stockpiler; Tie Back Shoring; Timber Faller and Bucker (hand labor); Toolroom Man (at job site); Tunnel Bullgang (above ground); Weight-Man-Crusher (aggregate when used)

GROUP 2: Applicator (including pot power tender for same), applying protective material by hand or nozzle on utility lines or storage tanks on project; Brush (power saw); Burners; Choker Splicer; Clary Power Spreader and similar types;

Clean up-nozzleman-Green cutter (concrete, rock, etc.);
Concrete
Laborer; Concrete Power Buggyman; Crusher Feeder;
Demolition and
Wrecking Charred Materials; Guniting Nozzleman Tender; Guniting
or
Sand Blasting Pot Tender; Handlers or Mixers of all
Materials of
an irritating nature (including cement and lime); Pipe
Doping &
Wrapping; Tool Operators (includes but not limited to: Dry
pack
machine, Jackhammer, Chipping guns, Paving breakers); Post
Hole
Digger, air, gas or electric; Vibrating Screed; Tampers;
Sand
Blasting (wet); Stake-Setter; Tunnel-Muckers, Brakemen,
Concrete
Crew, Bull gang (Underground)

GROUP 3: Asbestos Removal (structural removal only); Bit
Grinder; Drill Doctor; Drill Operators, air tracks cat
drills,
wagon drills, rubber-mounted drills, and other similar
types;

Concrete Saw Operator; Guniting Nozzleman; High scalers,
strippers
and drillers (covers work in swinging stages, chairs or
belts,
under extreme conditions unusual to normal drilling,
blasting,
barring-down, or sloping and stripping); Manhole Builder;
Powdermen; Power Saw Operators (Bucking and Falling);
Pumpcrete
Nozzlemen; Sand Blasting (dry); Sewer Timberman; Track
Liners;
Anchor Machines; Ballast Regulators; Multiple Tampers;
Power
Jacks; Tugger Operator; Tunnel-Chuck Tenders, Nippers and
Timbermen; Vibrator; Water Blaster

GROUP 4: Asphalt Raker; Concrete Saw Operator (walls);
Concrete Nozzelman; Grade Checker; Pipelayer; Laser Beam
(Tunnel)
applicable when assigned to move, set up, align laser beam;
Miner-Tunnel; Motorman-dinky Locomotive-Tunnel; Powderman-
Tunnel;

Shield Operator-Tunnel

GROUP 5: Traffic Flaggers

GROUP 6: Fence Builders

GROUP 7: Landscaping and Planting Laborers

ZONE DIFFERENTIAL (ADD TO ZONE 1 RATES):

ZONE 2 - \$0.65
ZONE 3 - 1.15
ZONE 4 - 1.70
ZONE 5 - 2.75

ZONE DEFINITIONS

BASE POINTS: GOLDENDALE, LONGVIEW, AND VANCOUVER

ZONE 1: Projects within 30 miles of the respective city hall

ZONE 2: More than 30 miles but less than 40 miles from the respective city hall.

ZONE 3: More than 40 miles but less than 50 miles from the respective city hall.

ZONE 4: More than 50 miles but less than 80 miles from the respective city hall.

ZONE 5: More than 80 miles from the respective city hall.

LAB00335K 06/01/2002

Rates

Fringes

PACIFIC(south of a straight line made by extending the north boundary of Wahkiakum County west to the Pacific Ocean)

HOD CARRIERS	25.04	6.15

PAIN0005A 07/01/2002

	Rates	
Fringes		
CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,		
MASON, PIERCE, SNOHOMISH AND THURSTON COUNTIES		
PAINTERS	23.27	5.36

PAIN0005C 06/10/2002

	Rates	
Fringes		
CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,		
MASON,		
PIERCE, SNOHOMISH AND THURSTON COUNTIES		
DRYWALL FINISHERS	26.18	10.46

PAIN0005H 07/01/2002

	Rates	
Fringes		
CHELAN AND KITTITAS COUNTIES		
PAINTERS:		
BRUSH, PAPERHANGER,		
STEAM-CLEANING, STRIPING and		
SPRAY	19.42	4.42
TV, RADIO, ELECTRICAL		
TRANSMISSION TOWERS	21.17	4.42

PAIN0005P 06/01/2002

	Rates	
Fringes		
CALLAM, GRAYS HARBOR, JEFFERSON, LEWIS, MASON, PACIFIC		
(NORTHERN		
PORTION), PIERCE AND THURSTON COUNTIES		
SOFT FLOOR LAYERS	21.47	7.92

PAIN0054G 09/01/2002

	Rates	
Fringes		
CHELAN AND KITTITAS COUNTIES		
GLAZIERS	18.32	3.17

PAIN0054I 06/01/2002

	Rates	
Fringes		
CHELAN AND KITTITAS COUNTIES		
DRYWALL FINISHER (TAPER)	20.88	5.16

PAIN0055M 07/15/2002

	Rates	
Fringes		
PACIFIC COUNTY		
DRYWALL FINISHERS	26.11	9.12

* PAIN0055N 07/01/2002

	Rates	
Fringes		
PACIFIC COUNTY		
PAINTERS:		
Brush & Roller	17.35	5.08
Spray and Sandblasting	17.95	5.08
High work - All work		
60 ft. or higher	18.10	5.08

* PAIN0188A 01/01/2003

	Rates	
Fringes		
CLALLAM, JEFFERSON, KING, KITSAP, LEWIS, MASON, PIERCE, SNOHOMISH AND THURSTON COUNTIES		
GLAZIERS	28.35	9.11

* PAIN0188B 01/01/2003

Rates

Fringes
GRAYS HARBOR AND PACIFIC COUNTIES

GLAZIERS	12.95	7.07
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PAIN1238D 06/01/2002

Rates

Fringes
KING, KITSAP AND SNOHOMISH COUNTIES

SOFT FLOOR LAYERS	22.64	7.94
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PLAS0072C 06/01/2002

Rates

Fringes
CHELAN AND KITTITAS COUNTIES

Zone 1: CEMENT MASONS	21.51	5.98
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Zone Differential (Add to Zone 1
rates): Zone 2 - \$2.00

BASE POINTS: Spokane, Pasco, Moses Lake, and Lewiston

Zone 1: 0 - 45 radius miles from the main post office

Zone 2: 45 radius miles from the main post office

PLAS0082D 06/01/2002

Rates

Fringes
PACIFIC (South of a straight line made by extending the
north
boundary line of Wahkiakum County west to the Pacific
Ocean) COUNTY

PLASTERERS	25.64	7.13

PLAS0528B 12/01/2002

Rates

Fringes
 CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS,
 MASON,
 PACIFIC (North of a straight line made by extending the
 north
 boundary line of Wahkiakum Count, west to the Pacific
 Ocean),
 PIERCE, SNOHOMISH AND THURSTON COUNTIES

CEMENT MASONS	28.05	
9.84		

PLUM0032A 06/01/2002

Rates

Fringes
 CHELAN AND KITTITAS (NORTHERN TIP) COUNTIES

PLUMBERS AND PIPEFITTERS	26.13	10.23
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PLUM0032B 01/01/2002

Rates

Fringes
 CLALLAM, KING AND JEFFERSON COUNTIES

PLUMBERS AND PIPEFITTERS	32.08	11.53
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PLUM0082D 08/01/2002

Rates

Fringes
 GRAYS HARBOR, LEWIS, MASON (EXCLUDING NE SECTION), PACIFIC,
 PIERCE AND THURSTON COUNTIES

PLUMBERS AND PIPEFITTERS	29.60	11.62
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* PLUM0265A 08/01/2002

Rates

Fringes
SNOHOMISH COUNTY

PLUMBERS AND PIPEFITTERS:	29.00	11.62
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PLUM0598B 06/01/2002

Rates

Fringes
KITITITAS (ALL BUT NORTHERN TIP)

PLUMBERS AND PIPEFITTERS	29.85	12.59
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PLUM0631A 08/01/2002

Rates

Fringes
MASON (NE SECTION),
AND KITSAP COUNTIES

PLUMBERS/PIPEFITTERS:
All new construction, additions,
and remodeling of commercial

building projects such as:
cocktail lounges and taverns,
professional buildings, medical
clinics, retail stores, hotels
and motels, restaurants and fast
food types, gasoline service
stations, and car washes where
the plumbing and mechanical cost
of the project is less than
\$100,000

19.20	4.58
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All other work where the plumbing
and mechanical cost of the project
is \$100,000 and over

27.84	11.62
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ROOF0054A 06/01/2002

	Rates	
Fringes		
CLALLAM, JEFFERSON, KING, KITSAP, MASON AND SNOHOMISH		
COUNTIES		
ROOFERS	25.37	8.41

	Rates	
R00F0153A 01/01/2003		
Fringes		
GRAYS HARBOR, LEWIS, PACIFIC, PIERCE AND THURSTON COUNTIES		
ROOFERS	25.25	6.69

	Rates	
R00F0189A 07/01/2002		
Fringes		
CHELAN COUNTY		
ROOFERS	20.15	6.15

	Rates	
R00F0189E 07/01/2002		
Fringes		
KITTITAS COUNTY		
ROOFERS	20.47	5.90

	Rates	
WA020002 - 1 SFWA0699B 07/01/2002		
Fringes		
KING, KITSAP, PIERCE, SNOHOMISH AND THURSTON COUNTIES		
SPRINKLER FITTERS	33.04	11.25

SHEE0066D 06/01/2002

	Rates	
Fringes		
CHELAN COUNTY		
SHEET METAL WORKERS	24.04	7.93

SHEE0066F 12/01/2002

	Rates	
Fringes		
CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC, PIERCE, SNOHOMISH AND THURSTON COUNTIES		
SHEET METAL WORKERS	30.90	11.75

SHEE0066M 06/01/2002

	Rates	
Fringes		
KITTITAS COUNTY		
SHEET METAL WORKERS	25.88	9.90

TEAM0174B 06/01/2002

	Rates	
Fringes		
CLALLAM, GRAYS HARBOR, JEFFERSON, KING, KITSAP, LEWIS, MASON, PACIFIC (North of a straight line made by extending the north boundary line of Wahkiakum County west to the Pacific Ocean), PIERCE, SNOHOMISH AND THURSTON COUNTIES		
TRUCK DRIVERS:		
ZONE A:		
GROUP 1:	25.79	9.68
GROUP 2:	25.21	9.68
GROUP 3:	22.81	9.68
GROUP 4:	18.56	9.68
GROUP 5:	25.55	9.68
ZONE B (25-45 miles from center of listed cities*):		
Add \$.70 per hour to Zone A rates.		

ZONE C (over 45 miles from centr of listed cities*):
Add \$1.00 per hour to Zone A rates.

*Zone pay will be calculated from the city center of the following listed cities:

BELLINGHAM	CENTRALIA	RAYMOND	OLYMPIA
EVERETT	SHELTON	ANACORTES	BELLEVUE
SEATTLE	PORT ANGELES	MT. VERNON	KENT
TACOMA	PORT TOWNSEND	ABERDEEN	BREMERTON

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1 - "A-frame or Hydralift" trucks and Boom trucks or similar equipment when "A" frame or "Hydralift" and Boom truck or similar equipment is used; Buggymobile; Bulk Cement Tanker; Dumpsters and similar equipment, Tournorockers, Tournowagon, Tournotrailer, Cat DW series, Terra Cobra, Le Tourneau, Westinghouse, Athye Wagon, Eucid Two and Four-Wheeled power tractor with trailer and similar top-loaded equipment transporting material: Dump Trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with

16 yards to 30 yards capacity: Over 30 yards \$.15 per hour additional for each 10 yard increment; Explosive Truck (field mix) and similar equipment; Hyster Operators (handling bulk loose aggregates); Lowbed and Heavy Duty Trailer; Road Oil Distributor Driver; Spreader, Flaherty Transit mix used exclusively in heavy construction; Water Wagon and Tank Truck-3,000 gallons and over capacity

GROUP 2 - Bulllifts, or similar equipment used in loading or unloading trucks, transporting materials on job site; Dumpsters, and similar equipment, Tournorockers, Tournowagon, Tournotrailer, Cat. D.W. Series, Terra Cobra, Le Tourneau, Westinghouse, Athye

wagon, Euclid two and four-wheeled power tractor with trailer and similar top-loaded equipment transporting material, Dump trucks, side, end and bottom dump, including semi-trucks and trains or combinations thereof with less than 16 yards capacity; Flatbed: (Dual Rear Axle); Grease Truck, Fuel Truck, Greaser, Battery Service Man and/or Tire Service Man; Leverman and loader at bunkers and batch plants; Oil tank transport; Scissor, Slurry Truck; Sno-Go and similar equipment; Swampers; Straddler Carrier (Ross, Hyster) and similar equipment; Team Driver; Tractor (small rubber-tired (when used within Teamster jurisdiction); Vacuum truck; Water Wagon and Tank trucks-less than 3,000 gallons capacity; Winch truck; Wrecker, tow truck and similar equipment

GROUP 3 - Flatbed: single rear axle; Pickup sweeper, Pickup Truck (Adjust upward by \$2.00 per hour for onsite work)

GROUP 4 - Escort or pilot driver

GROUP 5 - Mechanic

HAZMAT PROJECTS

Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium, in addition to the classification working in as follows:

LEVEL C: +\$.25 per hour - This level uses an air purifying respirator or additional protective clothing.

LEVEL B: +\$.50 per hour - Uses same respirator protection as

Level A. Supplied air line is provided in conjunction with a

chemical "splash suit."

LEVEL A: +\$.75 per hour - This level utilizes a fully-

encapsulated suit with a self-contained breathing apparatus
or a
supplied air line.

TEAM0760F 06/01/2002

Rates

Fringes
CHELAN AND KITTITAS COUNTIES

(ANYONE WORKING ON HAZMAT
JOBS SEE FOOTNOTE A BELOW)

TRUCK DRIVERS:

GROUP 1	19.33	8.50
GROUP 2	21.97	8.50
GROUP 3	22.08	8.50
GROUP 4	22.41	8.50
GROUP 5	22.52	8.50
GROUP 6	22.68	8.50
GROUP 7	23.22	8.50
GROUP 8	23.54	8.50

TRUCK DRIVERS CLASSIFICATIONS

GROUP 1: Escort Driver or Pilot Car; Employee Haul; Power
Boat
Hauling Employees or Material

GROUP 2: Fish Truck; Flat Bed Truck; Fork Lift (3000 lbs.
and
under); Trailer Mounted Hydro Seeder and Mulcher;
Leverperson
(loading trucks at bunkers); Seeder & Mulcher; Stationary
Fuel
Operator; Tractor (small, rubber-tired, pulling trailer or
similar equipment)

GROUP 3: Auto Crane (2000 lbs. capacity); Buggy Mobile &
Similar; Bulk Cement Tanks & Spreader; Dumptor (6 yds. &
under);
Flat Bed Truck with Hydraulic System; Fork Lift (3001-
16,000
lbs.); Fuel Truck Driver; Steamcleaner & Washer; Power
Operated

Sweeper; Rubber-tired Tunnel Jumbo; Scissors Truck; Slurry Truck
Driver; Straddle Carrier (Ross, Hyster, & similar);
Tireperson;
Transit Mixers & Truck Hauling Concrete (3 yd. to & including 6 yds.); Trucks, side, end, bottom and articulated end dump (3 yards to and including 6 yds.); Warehouseperson (to include shipping & receiving); Wrecker & Tow Truck

GROUP 4: A-Frame; Burner, Cutter, & Welder; Service Greaser;
Trucks, side, end, bottom and articulated end dump (over 6 yds. to & including 12 yds.); Truck Mounted Hydro Seeder; Warehouseperson; Water Tank truck (0-8000 gallons)

GROUP 5: Dumpster (over 6 yds.); Lowboy (50 tons & under); Self-Loading Roll Off; Semi-Truck & Trailer; Tractor with Steer Trailer; Transit Mixers and Trucks Hauling Concrete (over 6 yds. to and including 10 yds.); Trucks, side, end, bottom and articulated end dump (over 12 yds. to & including 20 yds.); Truck-Mounted Crane (with load bearing surface either mounted or pulled)(up to 14 ton); Vacuum Truck (super sucker, guzzler, etc.)

GROUP 6: Flaherty Spreader Box Driver; Flowboys; Fork Lift (over 16,000 lbs.); Dumps (Semi-end); Lowboy (over 50 tons); Mechanic (Field); Transfer Truck and Trailer; Transit Mixers & Trucks Hauling Concrete (over 10 yds. to & including 20 yds.); Trucks, side, end, bottom and end dump (over 20 yds. to & including 40 yds.); Truck and Pup; Tournarocker, DW's & similar with 2 or more 4 wheel-power tractor with trailer, gallonage or yardage scale, whichever is greater; Water Tank Truck (8,001-14,000 gallons)

GROUP 7: Oil Distributor Driver; Stringer Truck (cable operated

trailer); Transit Mixers & Hauling Concrete (over 20 yds.);

Truck, side, end, bottom and articulated end dump (over 40 yds.

to & including 100 yds.); Truck Mounted Crane (with load bearing

surface either mounted or pulled (16 through 25 tons)

GROUP 8: Prime Movers and Stinger Truck; Trucks, side, end,

bottom and articulated end dump (over 100 yds.);

Helicopter

Pilot Hauling Employees or Materials

Footnote A- Anyone working on a HAZMAT job, where HAZMAT certification is required, shall be compensated as a premium,

in addition to the classification working in as follows:

LEVEL D: - \$.25 PER HOUR (This is the lowest level of protection.

No respirator is used and skin protection is minimal.

LEVEL C: - \$.50 PER HOUR (This level uses an air purifying respirator or additional protective clothing.

LEVEL B: - \$.75 PER HOUR (Uses same respirator protection as

Level A. Supplied air line is provided in conjunction with a chemical "splash suit."

LEVEL A: - \$1.00 PER HOUR (this level utilizes a fully-encapsulated suit with a self-contained breathing apparatus or a supplied air line.

WELDERS - Receive rate prescribed for craft performing operation

to which welding is incidental.

=====
=====

Unlisted classifications needed for work not included within

the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses

(29 CFR 5.5(a)(1)(ii)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- * an existing published wage determination
- * a survey underlying a wage determination
- * a Wage and Hour Division letter setting forth a position on a wage determination matter
- * a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests

for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted

because those Regional Offices have responsibility for the Davis-Bacon survey program. If the response from this initial

contact is not satisfactory, then the process described in 2.)

and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch

of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator

(See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U. S. Department of Labor
200 Constitution Avenue, N. W.
Washington, D. C. 20210

4.) All decisions by the Administrative Review Board are final.

END OF GENERAL DECISION

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GENERAL DECISION **WA020014** 03/01/2002 WA14

Date: March 1, 2002

General Decision Number **WA020014**

Superseded General Decision No. WA010014

State: Washington

Construction Type:
RESIDENTIAL

County(ies):
PIERCE

RESIDENTIAL CONSTRUCTION PROJECTS (consisting of single
family
homes and apartments up to and including 4 stories)

Modification Number	Publication Date
0	03/01/2002

COUNTY(ies):
PIERCE

SUWA4002A 04/01/1982

	Rates	
Fringes		
CARPENTERS	13.79	2.66
CEMENT MASONS	12.89	
ELECTRICIANS	13.38	
LABORERS	7.71	
PAINTERS	10.53	1.34
PLUMBERS	11.24	
ROOFERS	15.13	2.42

WELDERS: Receive rate for craft performing operation to which welding is incidental.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29 CFR 5.5(a)(1)(v)).

In the listing above, the "SU" designation means that rates listed under that identifier do not reflect collectively bargained wage and fringe benefit rates. Other designations indicate unions whose rates have been determined to be prevailing.

WAGE DETERMINATION APPEALS PROCESS

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SECTION 01001

SUPPLEMENTARY REQUIREMENTS

PART 1 GENERAL

1.1 DEFINITIONS

The references listed below are to be defined as indicated wherever they may be used in the TECHNICAL SPECIFICATIONS.

"SUPPLEMENTARY REQUIREMENTS " shall be read to pertain to any of the sections of the DIVISION 1 as required by the content of the section or paragraph containing the reference.

1.2 CONSTRUCTION SCHEDULING

The instructions for preparation and submittal of the Contractor-prepared Network Analysis System are found in SECTION 01320, PROJECTSCHEDULE.

1.3 CORRESPONDENCE

1.3.1 All correspondence shall be addressed to the Administrative Contracting Officer, shall be serially numbered commencing with Number 1, with no numbers missing or duplicated and shall be furnished with an original and one copy. Enclosures attached or transmitted with the correspondence shall also be furnished with an original and one copy. Each serial letter shall make reference to the contract name, contract number and shall have only one subject.

1.3.2 All correspondence from the Contracting Officer will be also serially numbered with no numbers missing or duplicated. Letters to the Contractor will be forwarded in duplicate.

1.3.3 In the event there is more than one project within a contract, correspondence shall contain separate and distinct submittals to identify each project by name.

1.3.4 For submission of Contractor payment requests, See Section 01025, MEASUREMENT AND PAYMENT.

1.4 ADVANCED NOTICE OF CONTRACTOR PERFORMED ACCEPTANCE TESTING

The Contractor shall notify the Contracting Officer a minimum of 20 days prior to performing any acceptance or "buy off" testing of the following systems, (1) EMCS, (2) Fire Detection/Protection, (3) Intrusion Detection System, (4) Uninterruptible Power Supply, and (5) HVAC. Advance notification is not required for testing performed as part of fabrication or installation.

1.5 CONTRACTOR'S FILES

Contractor shall maintain "Approved (Action Code "A") and "Approved Except as Noted (Action Code "B") shop drawing files in fabrication shops and at project sites for government use.

1.6 AUDIO-VIDEO RECORDINGS

1.6.1 General

The Contractor shall provide all equipment, materials, and trained personnel to visually and audibly record (video tape) all on site operations and maintenance (O&M) training sessions for this contract. The video technician shall be employed by a video production company that has been in business for a minimum of 2 years. The Contractor shall submit the resume of the technician and video production company. Also the Contractor shall submit for approval an agenda or an outline breakdown of the proposed presentation. Video tapes shall be produced in the VHS format. Audio shall be adjusted, filtered or otherwise controlled to ensure that the trainer can be understood at all times. Each system or piece of equipment shall be covered in a single tape or set of tapes which shall be correlated with the O&M manuals provided. Video tapes and their individual storage cases shall be identified with a typewritten label showing the project, equipment or system, and contract number; this same information shall be provided as an introduction on each video tape. When two or more tapes are provided, they shall be submitted as a set in an appropriate storage container.

1.6.2 Submittals

Prior to conducting the training sessions the following shall be submitted for approval:

- 1) A training plan consisting of the agenda or an outline breakdown of the proposed presentation and
- 2) The qualifications of the trainer and the video recording technician

Two copies of the video taped material shall be submitted to the Contracting Officer within 10 days after completion of video taping the training sessions.

1.7 MECHANICAL AND ELECTRICAL LAYOUT DRAWINGS

The Contractor shall submit, for Contracting Officer's approval, scaled layout drawings, including appropriate elevations and sections, as required, showing the room arrangement the Contractor proposes for all pieces of mechanical and electrical equipment and appurtenances thereto, such as but not limited to: air conditioning equipment, boilers, compressors, hot water tanks, pumps, electrical control panels, ducts and piping that are to be located in the room. Mechanical and electrical layouts shall be coordinated to eliminate any conflicts of installed equipment. No payments will be made to the Contractor for furnishing or installing equipment until the layout drawings have been approved by the Contracting Officer. Mechanical and electrical equipment layout drawings shall be identified and submitted as specified herein. Equipment rooms shown on the drawings are of adequate size to accommodate equipment of required capacities as available from several manufacturers with sufficient space left for access, servicing, and removal. The use of equipment items with dimensions such as "to crowd the space" will not be permitted.

1.8 PROJECT PHOTOGRAPHS

1.8.1 General

The Contractor shall furnish photographs depicting construction as specified herein. The photographs shall be in digital JPEG format, with a resolution of 1024 x 768 pixels or better, size limited to less than 300KB. Photos shall be submitted in a Word document, with a caption under each photo showing date taken, project location, contract title and number, and a brief description of what the photo depicts. The photos shall be submitted on a 133 mm ISO-9660 CD-ROM.

1.8.2 Progress Photographs

Construction progress photographs shall be taken between the 1st and 15th of each month and delivered to the Contracting Officer with the payment request for the month taken. Photos shall be taken from 10 positions. Location of positions shall be coordinated with or may be selected by the Contracting Officer. They shall show, inasmuch as practicable, work accomplished during the previous month. Photographic quality and composition of photos shall be such that they can be used for briefings and/or to illustrate articles on the construction progress of the project.

1.8.3 Completion Photographs

Construction completion photographs, in the same format as the progress photographs, shall be taken upon completion of construction and delivered to the Contracting Officer not later than 15 days prior to project completion. It is the intention of the Government to obtain slides whose color, clarity, and composition are such that they can be used for briefings and/or to illustrate articles on the completed project. Slides shall be taken from 10 positions. Location of positions shall be coordinated with or may be selected by the Contracting Officer. Slides shall show the completed project to the best advantage, and shall include overall site photos as well as photos of major features.

1.9 COLOR BOARDS

Three sets of color boards shall be submitted within 60 calendar days after receipt of Notice to Proceed. The board shall include samples of colors and finishes of every finish such as on walls, floors, and ceilings. This would include, but not be limited to, paint, floor and wall tile, acoustical panels, carpet, wall base, plastic laminate, etc. Where special finishes such as architectural concrete or prefinished metal panels are required, samples of not less than 305 mm (12 inches) square shall be submitted with the board. Boards shall include, where applicable, color samples of integrally colored block, brick, and prefinished metal roofing and siding. The board shall be 610 mm by 610 mm (24 inches by 24 inches). If more space is needed, more than one board per set may be submitted. This is not meant to replace the samples called for in other portions of the specifications. The Contractor shall certify that he has reviewed the color boards in detail and that they are in strict accordance with the contract drawings and specifications, except as may be otherwise explicitly stated.

1.10 SAMPLE ROOM

After all finish materials have been submitted and approved, but prior to the installation of any of them, the Contractor shall construct and completely finish one sample room that is/will be representative of all other rooms. Finishes shall include, but not necessarily be limited to, paint, wall covering of any type, floor finish of any type including base, ceiling finish of any type, and all electrical and mechanical finish trim. No payment will be made for any installation of finish materials until this room has been constructed and approved by a representative of the Contracting Officer. Once approved, this room shall serve as the "model" for finish and workmanship of all other rooms in the facility.

1.11 IDENTIFICATION OF EMPLOYEES AND MILITARY REGULATIONS:

(a) The Contractor shall be responsible for compliance with all regulations and orders of the Commanding Officer of the Military Installation, respecting identification of employees, movements on installation, parking, truck entry, and all other military regulations which may affect the work.

(b) The work under this Contract is to be performed at an operating Military Installation with consequent restrictions on entry and movement of nonmilitary personnel and equipment.

(c) The Commanding Officer of Fort Lewis, Washington, has initiated the following specific requirement regarding vehicle registration for this contract.

Contractors performing work on Fort Lewis shall, after award, register all vehicles to be used on the installation with the Vehicle Registration Section of the Law Enforcement Command. Contractor employees entering the installation in privately owned vehicles (POVs) shall also register their vehicles. A copy of contract award, proof of liability insurance, current driver's license and state vehicle registration shall be required to register Contractor, subcontractor, and employee vehicles.

Upon completion of the contract, it shall be the prime contractor's responsibility to collect all vehicle decals issued under the contract including those issued to employees and subcontractors. Decals are to be carefully removed from the vehicle, placed in an envelope and attached to the original documentation (i.e., post vehicle registration document) received with the decal. Decals, with documentation, must be returned to Vehicle Registration, Building 2140. Proof of decal clearance for all vehicles registered under this contract will be issued to the prime contractor and shall be returned to the Contracting Officer prior to final payment.

In the event of contract extension, it shall be the prime contractor's responsibility to report time extension to Vehicle Registration, with evidence of same. For further information, contact Vehicle Registration at Waller Hall, Building 2140 (Telephone: (253) 967-5065), Fort Lewis, Washington 98433-9500.

(d) Employee Access and Identification: The employee who requires access to Fort Lewis to perform work under this contract shall obtain a Government issued identification badge.

1. Employee Access: The contractor shall, prior to the contract start date, provide the sponsoring agency the name of the employee who shall require access to Fort Lewis to

perform work. This notification shall include the employee's last name, first name and middle initial and the employee's Social Security Number. The contractor shall ensure that the employee obtains a badge prior to beginning performance. Contractor employees hired during the term of the contract must obtain the badge before beginning work under the contract. If an employee no longer needs a badge for any reason (e.g., quits his/her job or is no longer performs work under the contract), the Contractor shall return the badge to the Contracting Officer's Representative (COR) within two (2) calendar days of such change. If the badge cannot be returned within the required time frame for any reason, the contractor shall immediately notify the COR verbally, followed up in writing the next work day. An employee's inability to obtain entrance to a Government installation because he/she does not have the required Government provided ID badge shall not excuse timely performance of the requirements of this contract. The Government may change the location(s) at which badges are issued or returned, with or without advance notice to the Contractor, at no additional cost to the Government as a result thereof.

2. Contractor Request for Government Identification Badge. The required information shall be submitted to the Sponsoring Agency on the form entitled *CONTRACTOR REQUEST FOR GOVERNMENT IDENTIFICATION BADGE (S)*. The form is on the Directorate of Contracting web page and may be accessed at web address <http://150.192.40.37:82>. After approval by a Contracting Officer, contractor shall be directed to have employee(s) report to a specified building to obtain their badges.

3. Lost or Stolen Badges. Government provided ID badges shall not be reproduced or copied by the Contractor, its subcontractors, or their employees. If an employee's badge is lost or stolen the Contractor shall verbally report the loss or theft to the COR on the day such loss or theft is discovered; followed by a written report of the circumstances to the Contracting Officer. The written report shall be completed one (1) calendar day after the loss or theft is discovered.

4. Use and Wear of Badge. Each contractor employee shall wear Government furnished identification badge while performing work under the contract. The badge shall be worn on the upper front of the outer garment unless precluded by OSHA regulation(s). The badge shall not be used for access to any Government installation except for performance of work under the contract for which it was issued.

5. Expiration/Termination. The contractor shall, upon expiration or termination of the contract, collect all badges and turn them in to the COR. The final invoice will not be considered proper for purposes of the Prompt Payment Act (FAR 52.232-25, in Section I) until all badges have been accounted for.

6. Compliance with Rules, Regulations, and Statutes. All contractor employees shall observe and comply with all applicable local, State, and Federal rules, regulations, and statutes including those concerning fire, safety, sanitation, security, vehicle safety, and hazardous material handling.

7. Firearms. Contractor personnel while performing work under this contract shall carry no firearms.

8. Entrance Denial by Military Police. Contractor employees may be denied entry to the Installation by Military Police if it is determined that such entry may be contrary to good order, discipline, or the security of the Installation.

1.12 PRESERVATION OF HISTORICAL, ARCHEOLOGICAL AND CULTURAL RESOURCES (1985 JAN OCE):

If, during construction activities, the Contractor observes items that might have historical or archeological value, such observations shall be reported immediately to the Contracting Officer so that the appropriate authorities may be notified and a determination can be made as to their significance and what, if any, special disposition of the finds should be made. The Contractor shall cease all activities that may result in the destruction of these resources and shall prevent his employees from trespassing on, removing, or otherwise damaging such resources.

1.13 SPECIAL SAFETY REQUIREMENTS:

All construction activities shall be conducted in strict compliance with the Corps of Engineers Safety and Health Requirements Manual EM 385-1-1, and Occupational Safety and Health Administration regulations, as applicable. The manual is available on line at: <http://www.usace.army.mil/inet/usace-docs/eng-manuals/em385-1-1/toc.htm>

1.13.1 In addition to Safety and Health Requirements Manual EM 385-1-1, and all applicable OSHA standards, the Contractor shall comply with the requirements listed below. Paragraph numbers refer to EM 385-1-1 or are added thereto.

(a) Paragraph 01.A.12: Add new paragraph: Safety Engineer (1985 JAN OCE) (DAM 52.236/103):

(1) The Contractor shall employ at the project site to cover all hours of work at least one Safety and Occupational Health person to manage the Contractor's accident program. Duties which are not germane to the safety program shall not be assigned to the Safety and Health person(s). The principal safety person shall report to and work directly for the Contractor's on-site top manager, higher level official, or corporate safety office. The Safety and Health person(s) shall have the authority to take immediate steps to correct unsafe or unhealthful conditions. The presence of a Safety and Health person will not abrogate safety responsibilities of other personnel.

(2) Qualifications for Safety and Health person(s).

(A) Shall have a degree in engineering or safety in at least a four-year program from an accredited school; or

(B) Shall have legal registration as a Professional Engineer or a Certified Safety Professional and, in addition, shall have been engaged in safety and occupational health for at least one (1) year of experience, no time being credited to this one (1) year unless at least fifty (50) percent of the time each year was devoted to safety and occupational health; or

(C) Shall have a degree other than that specified in (A) above and, in addition, shall have been engaged in safety and occupational health for at least three (3) years' no time being

credited to these three (3) years unless fifty (50) percent of the time each year was devoted to safety and occupational health; or

(D) In lieu of a degree, shall have been engaged in safety and occupational health for at least five (5) years, no time being credited to these (5) years unless at least fifty (50) percent of the time each year was devoted to safety and occupational health;

(E) First aid work is not a creditable experience.

(3) The name and qualifications of the nominated safety person(s) shall be furnished to the Contracting Officer for acceptability and a functional description of duties shall be provided prior to the pre-work conference.

(b) Paragraph 01.D.02, revise as follows:

(1) Replace paragraph 01.D.02c with the following:

"c. Property damage in excess of \$2,000.00

(2) Add new paragraph d as follows:

"An injury resulting in a lost workday, not including the day of injury."

1.14 TIME EXTENSIONS FOR UNUSUALLY SEVERE WEATHER (ER 415-1-15 31 OCT 89)

This Paragraph specifies the procedure for the determination of time extensions for unusually severe weather in accordance with the CONTRACT CLAUSE entitled "Default (Fixed Price Construction)". In order for the Contracting Officer to award a time extension under this clause, the following conditions must be satisfied:

1.14.1 The weather experienced at the project site during the contract period must be found to be unusually severe, that is, more severe than the adverse weather anticipated for the project location during any given month.

1.14.2 The unusually severe weather must actually cause a delay to the completion of the project. The delay must be beyond the control and without the fault or negligence of the contractor.

1.14.3 The following schedule of monthly anticipated adverse weather delays is based on National Oceanic and Atmospheric Administration (NOAA) or similar data for the project location and will constitute the base line for monthly weather time evaluations. The contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependent activities.

MONTHLY ANTICIPATED ADVERSE WEATHER DELAY WORK DAYS BASED ON (5) DAY WORK WEEK

<u>JAN</u>	<u>FEB</u>	<u>MAR</u>	<u>APR</u>	<u>MAY</u>	<u>JUN</u>	<u>JUL</u>	<u>AUG</u>	<u>SEP</u>	<u>OCT</u>	<u>NOV</u>	<u>DEC</u>
9	8	8	4	2	3	1	2	4	7	10	10

1.14.4 Upon acknowledgment of the notice to proceed (NTP) and continuing throughout the contract, the contractor will record on the daily QCQ report, the occurrence of adverse weather and resultant impact to normally scheduled work. Actual adverse weather delays must prevent work on critical activities for 50 percent or more of the contractor's scheduled work day.

1.14.5 The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in previous month), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the number of actual adverse weather delay days exceeds the number of days anticipated in paragraph 1.15.3, above, the Contracting Officer will convert any qualifying delays to calendar days, giving full consideration for equivalent fair weather work days, and issue a modification in accordance with the contract clause entitled " Default (Fixed Price Construction)".

1.15 COMPLIANCE WITH DAVIS-BACON ACT

1.15.1 Contractor POC

Within 14 days after award of the contract, the Contractor shall designate a point of contact (POC) within their organization who will be responsible for the Davis-Bacon Act Labor Program for the Contractor and all subcontractors under this contract as required by the Contract Clauses and FAR 52.222.

1.15.2 Responsibilities

The designated Contractor POC shall be responsible for Davis-Bacon Act Labor Program activities including, but not limited to:

- Documentation and record keeping
- Submittal and accuracy of certified payrolls
- Submittal of required labor forms including requests for additional classifications and rates, Statements and Acknowledgement, etc.
- Posting of the wage determination, approved additional classifications and rates, labor and EEO posters
- Coordination with the Contracting Officer's Labor Program POC

Prior to submittal to the Government, payrolls shall be reviewed for compliance to all applicable labor standards, to include, but not be limited to the following items: correct wage rates, correct overtime classification and pay, misclassification of workers for work actually performed, apprentice to journeyman ratios, and registration of apprentice. Corrective actions shall be taken as necessary to ensure Contractor compliance with applicable contract and FAR clauses.

1.15.3 Certification

The Contractor POC shall provide a signed certification stating the following: "I certify that the submitted items being forwarded have been reviewed in detail and are correct and in strict conformance with the Labor Standards of the contract except as otherwise stated."

PARTS 2 AND 3 NOT USED

END OF SECTION

SECTION 01005

SITE SPECIFIC SUPPLEMENTARY REQUIREMENTS

1. CONDUCT OF WORK

1.1 COORDINATION AND ACCESS TO SITE

1.1.1 Coordination with using agencies shall be made through the Contracting Officer to assist the Contractor in completing the work with a minimum of interference and inconvenience.

1.1.2 Vehicle Access:

1.1.2.1 All Contractor-owned and privately-owned vehicles require an access pass/vehicle decal. This pass is obtained from the Fort Lewis Vehicle Registrar, Building 2140 (Waller Hall) by showing proof of insurance; the vehicle registration; Washington State driver's license; and a letter with original signature of prime Contractor or his superintendent stating the contract name and number, the contract period for which the pass is required, and the employee's name. See Paragraph IDENTIFICATION OF EMPLOYEES AND MILITARY REGULATIONS in SECTION 01001 for specific requirements.

1.1.2.2 Commercial vehicle access to Fort Lewis will be allowed at the Logistic Center Gate (Exit 123 from I-5). The Logistics Center Gate is open for inbound commercial vehicle access and inspection from 0530 hours to 2000 hours, Monday through Friday. **All commercial vehicles will be searched.** Drivers should anticipate delays.

1.1.2.3 If the commercial vehicle is a cement concrete truck carrying a load for delivery, carrying a load of hot asphalt concrete for delivery, or a garbage or refuse collection truck, the driver shall notify the gate guard as soon as possible and request that the vehicle be given priority for being searched; however, the Government does not guarantee that the vehicle will be given priority.

1.1.2.4 Large vehicles (needing greater than 12'-5" clearance) will require a time-stamped "searched" label to gain access to North Fort Lewis. "Searched" labels will be issued at the Logistic Center Gate. Drivers of such vehicles needing access to North Fort Lewis must declare that their vehicle is over 12'-5" in height and that they will require access to North Fort Lewis to receive a briefing on proper procedures and a "searched" label.

1.1.2.5 Commercial vehicles less than 12'-5" in height shall access North Fort Lewis **only** via the Pendleton Avenue Overpass once they are cleared through the Logistic Center Gate.

1.1.2.6 Procedures for commercial vehicle access to Fort Lewis are subject to change without prior notice.

1.1.3 When keys are required for access to facilities on this contract, they shall be obtained through the Contracting Officer.

1.1.3.1 The Contractor shall be responsible for Government-owned keys issued for access to facilities or areas pertinent to this contract.

1.1.3.2 Upon completion of the work in an area, or upon request of the Contracting Officer, the key or keys relevant to the completed areas shall be returned.

1.1.3.3 Should the Contractor lose a key:

a. the Contracting Officer shall be notified, in writing, within three (3) working days after the loss is discovered and

b. should the key not be found before final acceptance, the final contract payment shall be reduced by \$100 for each key not returned.

1.1.4 Work hours in the construction area will be restricted to 7:30 a.m. to 4 p.m. daily, Monday through Friday, excluding Federal holidays. Work hours other than as specified above shall be coordinated with and approved by the Contracting Officer.

1.1.5 Contractor's workmen shall have on either a uniform with the firm name and the workman's last name or shall have a badge pinned on with both the firm name and the workman's photograph and full name.

1.2 UTILITY OUTAGES

Contractor shall coordinate utility outages with the Contracting Officer at least 7 days in advance. Outages shall be kept to a minimum and any one outage shall not last more than 2 hours.

1.3 PROTECTION OF GOVERNMENT PROPERTY

In addition to requirements of the CONTRACT CLAUSES, Contractor shall protect all Government property within the buildings in which he is working, except for such property as is required to be demolished. Property which is to be demolished shall be protected until its scheduled demolition time. Protection shall include, but not be limited to, protection from construction generated dust, debris, water, and vibration.

END OF SECTION

SECTION 01025

PAYMENT

PART 1 GENERAL

1.1 GENERAL

The contract price for each item shall constitute full compensation for furnishing all plant, labor, materials, appurtenances, and incidentals and performing all operations necessary to construct and complete the items in accordance with these specifications and the applicable drawings, including surveying performed by the Contractor. Payment for each item shall be considered as full compensation, notwithstanding that minor features may not be mentioned herein. Work paid for under one item will not be paid for under any other item. No separate payment will be made for the work, services, or operations required by the Contractor, as specified in DIVISION 1, GENERAL REQUIREMENTS, to complete the project in accordance with these specifications; all costs thereof shall be considered as incidental to the work.

1.2 PAYMENT

1.2.1 ITEM 0001 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0001, All Work for FY 03 Whole Barracks Renewal, Except for Items 0002 through 0015, payment of which shall constitute full compensation for Item No. 0001, complete.

1.2.2 ITEM 0002 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0002, All Work for Two Barrack A Buildings, payment of which shall constitute full compensation for Item No. 0002, complete.

1.2.3 ITEM 0003 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0003, All Work for Two Barrack B Buildings, payment of which shall constitute full compensation for Item No. 0003, complete.

1.2.4 ITEM 0004 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0004, All Work for Two Barrack C Buildings, payment of which shall constitute full compensation for Item No. 0004, complete.

1.2.5 ITEM 0005 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0005, All Work for Two Soldier Community Buildings, payment of which shall constitute full compensation for Item No. 0005, complete.

1.2.6 ITEM 0006 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0006, All Work for the Large Battalion Headquarters Building, payment of which shall constitute full compensation for Item No. 0006, complete.

1.2.7 ITEM 0007 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0007, All Work for Two Medium Company Operations Buildings, payment of which shall constitute full compensation for Item No. 0007, complete.

1.2.8 ITEM 0008 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0008, All Work for Five Lawnmower Storage Buildings, payment of which shall constitute full compensation for Item No. 0008, complete.

1.2.9 ITEM 0009 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0009, All Landscape and Irrigation Work for Echo Block, Except for Item 0011, payment of which shall constitute full compensation for Item No. 0009, complete.

1.2.10 ITEM 0010 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0010, All Landscape Work for 41st Division Drive and Related Areas, Except for Items 0011 and 0012, payment of which shall constitute full compensation for Item No. 0010, complete.

1.2.11 ITEM 0011 (BASE ITEM)

Payment will be made that the contract unit price for Item No. 0011, All Work for Removal and Offsite Disposal of Scot's (Scotch) Broom (*Cytisus scoparius*) at 41st Division Drive Project, payment of which shall constitute full compensation for Item No. 0011, complete.

1.2.12 ITEM 0012 (BASE ITEM)

Payment will be made that the contract lump sum price for Item No. 0012, All Work to Provide Landscape Maintenance and Irrigation Maintenance for One-Year Plant Establishment Period (see Specification 02935), payment of which shall constitute full compensation for Item No. 0012, complete.

1.2.13 ITEM NO. 0013 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0013, All Work for As-Built Drawings as specified in Section 01702 from preparation to final approval, payment of which shall constitute full compensation of Item No. 0013 complete. No partial or total payment will be made for this item until the as-built drawings, both marked up blue prints and electronic files are fully approved by the Government (A or B action) and all copies of approved drawings and electronic media received by the Government

1.2.14 ITEM 0014 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0014, All Work for O&M Manuals as specified in Section 01701 from preparation to final approval, payment of which shall constitute full compensation of Item No. 0014 complete. No partial or total payment will be made for this item until all O&M manuals are fully approved by the Government (A or B action) and all copies of final manuals are received by the Government in their final binders.

1.2.15 ITEM 0015 (BASE ITEM)

Payment will be made at the contract lump sum price for Item No. 0015, All Work for Form 1354 Checklist and Equipment in Place List as specified in Sections 01704 and 01705 from preparation to final approval, payment of which shall constitute full compensation of Item No. 0015 complete. No partial or total

payment will be made for this item until both the 1354 Checklist and Equipment in Place List are fully approved by the Government (A or B action) and all copies of approved lists received by the Government.

1.3 PROGRESS PAYMENT INVOICE

Requests for payment shall be submitted in accordance with Federal Acquisition Regulations (FAR) Subpart 32.9, entitled "PROMPT PAYMENT", and Paragraphs 52.232-5 and 52.232-27, entitled "Payments Under Fixed-Price Construction Contracts", and "Prompt Payment for Construction Contracts", respectively. In addition each request shall be submitted in the number of copies and to the designated billing office as shown in the Contract.

PARTS 2 and 3 NOT USED

PROGRESS PAYMENT INVOICE

See Federal Acquisition Regulations (FAR) 32.900, 52.232-5, & 52.232-27

1. PROJECT AND LOCATION		2. DATE	
3. CONTRACTOR NAME AND ADDRESS (Must be the same as in the Contract)		4. CONTRACT NO.	
		5. INVOICE NO.	
6. DESCRIPTION OF WORK		7. PERIOD OF PERFORMANCE From: To:	
8. DISCOUNT TERMS			
9. OFFICIAL TO WHOM PAYMENT IS TO BE FORWARDED Name: Title: Phone: () -		10. OFFICIAL TO BE NOTIFIED OF DEFECTIVE INVOICE Name: Title: Phone () -	
11. CERTIFICATION: I hereby certify, to the best of my knowledge and belief, that (1) The amounts requested are only for the performance in accordance with the specifications, terms, and conditions of this contract; (2) Payments to subcontractors and suppliers have been made from previous payments received under the contract, and timely payments will be made from the proceeds of the payment covered by this certification, in accordance with subcontract agreements and the requirements of Chapter 39 of Title 31, United States Code; and (3) This request for progress payment does not include any amounts which the prime contractor intends to withhold or retain from a subcontractor or supplier in accordance with the terms and conditions of the subcontract.			
(Signature)		(Title)	
		(Date)	
12. OTHER INFORMATION OR DOCUMENTATION required by Contract. Provide two (2) copies of each (check and attach if applicable): <input type="checkbox"/> Updated Progress Chart/Schedule <input type="checkbox"/> Progress Narrative <input type="checkbox"/> Certified Payrolls (submitted weekly) <input type="checkbox"/> Safety Exposure Report <input type="checkbox"/> Updated Submittal Register <input type="checkbox"/> Progress Photos <input type="checkbox"/> Subcontractor/Employee Listings		(FOR GOVERNMENT USE ONLY) Retainage: ____% Amt.: \$_____ Withholdings: \$_____ Reason: _____ Following items are current: As-Builts ____ Yes ____ No O & M Manuals ____ Yes ____ No 1354 Data ____ Yes ____ No Submittal Register ____ Yes ____ No	

END OF SECTION

SECTION 01035

MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 PROPOSED PROJECT MODIFICATIONS:

Price proposals for proposed modifications shall be submitted in accordance with the requirements of the Contract Clause MODIFICATION PROPOSALS - PRICE BREAKDOWNS. If change order work impacts or delays other unchanged contract work, the costs of such impacts or delays shall be included in the proposals and separately identified. Additional instructions for submitting price proposals can be found in NPSP-415-1-1, INSTRUCTION AND INFORMATION FOR CONTRACTORS, a copy of which will be furnished to the Contractor at the Preconstruction Conference. For information applicable to equipment rates used in contract modifications, refer to 00800 - SPECIAL CLAUSES, clause "EQUIPMENT OWNERSHIP AND OPERATING EXPENSE SCHEDULE".

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

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SECTION 01312

QUALITY CONTROL SYSTEM (QCS)

1.1 GENERAL

The Government will use the Resident Management System for Windows (RMS) to assist in its monitoring and administration of this contract. The Contractor shall use the Government-furnished Construction Contractor Module of RMS, referred to as QCS, to record, maintain, and submit various information throughout the contract period. This joint Government-Contractor use of RMS and QCS will facilitate electronic exchange of information and overall management of the contract. QCS provides the means for the Contractor to input, track, and electronically share information with the Government in the following areas:

- ?? Administration
- ?? Finances
- ?? Quality Control
- ?? Submittal Monitoring
- ?? Scheduling
- ?? Import/Export of Data

1.1.1 Correspondence and Electronic Communications

For ease and speed of communications, both Government and Contractor will, to the maximum extent feasible, exchange correspondence and other documents in electronic format. Correspondence, pay requests and other documents comprising the official contract record shall also be provided in paper format, with signatures and dates where necessary. Paper documents will govern, in the event of discrepancy with the electronic version.

1.1.2 Other Factors

Particular attention is directed to Contract Clause, "Schedules for Construction Contracts", Contract Clause, "Payments", Section 01320, PROJECT SCHEDULE, Section 01330, SUBMITTAL PROCEDURES, and Section 01451, CONTRACTOR QUALITY CONTROL, which have a direct relationship to the reporting to be accomplished through QCS. Also, there is no separate payment for establishing and maintaining the QCS database; all costs associated therewith shall be included in the contract pricing for the work.

1.2 QCS SOFTWARE

QCS is a Windows-based program that can be run on a stand-alone personal computer or on a network. The Government will make available the QCS software to the Contractor after award of the construction contract. Prior to the Pre-Construction Conference, the Contractor shall be responsible to download, install and use the latest version of the QCS software from the Government's RMS Internet Website. Upon specific justification and request by the Contractor, the Government can provide QCS on (3-1/2 inch) high-density diskettes or CD-ROM. Any program updates of QCS will be made available to the Contractor via the Government RMS Website as they become available.

1.3 SYSTEM REQUIREMENTS

The following listed hardware and software is the minimum system configuration that the Contractor shall have to run QCS:

Hardware

- ?? IBM-compatible PC with 200 MHz Pentium or higher processor
- ?? 32+ MB RAM
- ?? 4 GB hard drive disk space for sole use by the QCS system
- ?? 3 1/2 inch high-density floppy drive
- ?? Compact disk (CD) Reader
- ?? Color monitor
- ?? Laser printer compatible with HP LaserJet III or better, with minimum 4 MB installed memory.
- ?? Connection to the Internet, minimum 28 BPS

Software

- ?? MS Windows 95 or newer version operating system (MS Windows NT 4.0 or newer is recommended)
- ?? Word Processing software compatible with MS Word 97 or newer
- ?? Internet browser
- ?? The Contractor's computer system shall be protected by virus protection software that is regularly upgraded with all issued manufacturer's updates throughout the life of the contract.
- ?? Electronic mail (E-mail) compatible with MS Outlook

1.4 RELATED INFORMATION

1.4.1 QCS User Guide

After contract award, the Contractor shall download instructions for the installation and use of QCS from the Government RMS Internet Website; the Contractor can obtain the current address from the Government. In case of justifiable difficulties, the Government will provide the Contractor with a CD-ROM containing these instructions.

1.4.2 Contractor Quality Control(CQC) Training

The use of QCS will be discussed with the Contractor's QC System Manager during the mandatory CQC Training class.

1.5 CONTRACT DATABASE

Prior to the pre-construction conference, the Government shall provide the Contractor with basic contract award data to use for QCS. The Government will provide data updates to the Contractor as needed, generally by files attached to E-mail. These updates will generally consist of submittal reviews, correspondence status, QA comments, and other administrative and QA data.

1.6 DATABASE MAINTENANCE

The Contractor shall establish, maintain, and update data for the contract in the QCS database throughout the duration of the contract. The Contractor shall establish and maintain the QCS database at the Contractor's site office. Data updates to the Government shall be submitted by E-mail with file attachments, e.g., daily reports, schedule updates, payment requests. If permitted by the Contracting Officer, a data diskette or CD-ROM may be used instead of E-mail (see Paragraph DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM). The QCS database typically shall include current data on the following items:

1.6.1 Administration

1.6.1.1 Contractor Information

The database shall contain the Contractor's name, address, telephone numbers, management staff, and other required items. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver Contractor administrative data in electronic format via E-mail.

1.6.1.2 Subcontractor Information

The database shall contain the name, trade, address, phone numbers, and other required information for all subcontractors. A subcontractor must be listed separately for each trade to be performed. Each subcontractor/trade shall be assigned a unique Responsibility Code, provided in QCS. Within 14 calendar days of receipt of QCS software from the Government, the Contractor shall deliver subcontractor administrative data in electronic format via E-mail.

1.6.1.3 Correspondence

All Contractor correspondence to the Government shall be identified with a serial number. Correspondence initiated by the Contractor's site office shall be prefixed with "S". Letters initiated by the Contractor's home (main) office shall be prefixed with "H". Letters shall be numbered starting from 0001. (e.g., H-0001 or S-0001). The Government's letters to the Contractor will be prefixed with "C".

1.6.1.5 Equipment

The Contractor's QCS database shall contain a current list of equipment planned for use or being used on the jobsite, including the most recent and planned equipment inspection dates.

1.6.1.7 Management Reporting

QCS includes a number of reports that Contractor management can use to track the status of the project. The value of these reports is reflective of the quality of the data input, and is maintained in the various sections of QCS. Among these reports are: Progress Payment Request worksheet, QA/QC comments, Submittal Register Status, Three-Phase Inspection checklists.

1.6.2 Finances

1.6.2.1 Pay Activity Data

The QCS database shall include a list of pay activities that the Contractor shall develop in conjunction with the construction schedule. The sum of all pay activities shall be equal to the total contract amount, including modifications. Pay activities shall be grouped by Contract Line Item Number (CLIN), and the sum of the activities shall equal the amount of each CLIN. The total of all CLINs equals the Contract Amount.

1.6.2.2 Payment Requests

All progress payment requests shall be prepared using QCS. The Contractor shall complete the payment request worksheet and include it with the payment request. The work completed under the contract, measured as percent or as specific quantities, shall be updated at least monthly. After the update, the Contractor shall generate a payment request report using QCS. The Contractor shall submit the payment requests with supporting data by E-mail with file attachment(s). If permitted by the Contracting Officer, a data diskette may be used instead of E-mail. A signed paper copy of the approved payment request is also required, which shall govern in the event of discrepancy with the electronic version.

1.6.3 Quality Control (QC)

QCS provides a means to track implementation of the 3-phase QC Control System, prepare daily reports, identify and track deficiencies, document progress of work, and support other contractor QC requirements. The Contractor shall maintain this data on a daily basis. Entered data will automatically output to the QCS generated daily report. The Contractor shall provide the Government a Contractor Quality Control (CQC) Plan within the time required in Section 01451, CONTRACTOR QUALITY CONTROL. Within seven calendar days of Government acceptance, the Contractor shall submit a data diskette or CD-ROM reflecting the information contained in the accepted CQC Plan: schedule, pay activities, features of work, submittal register, QC requirements, and equipment list.

1.6.3.1 Daily Contractor Quality Control (CQC) Reports.

QCS includes the means to produce the Daily CQC Report. The Contractor may use other formats to record basic QC data. However, the Daily CQC Report generated by QCS shall be the Contractor's official report. Data from any supplemental reports by the Contractor shall be

summarized and consolidated onto the QCS-generated Daily CQC Report. Daily CQC Reports shall be submitted as required by Section 01451, CONTRACTOR QUALITY CONTROL. Reports shall be submitted electronically to the Government using E-mail or diskette within 24 hours after the date covered by the report. Use of either mode of submittal shall be coordinated with the Government representative. The Contractor shall also provide the Government a signed, printed copy of the daily CQC report.

1.6.3.2 Deficiency Tracking.

The Contractor shall use QCS to track deficiencies. Deficiencies identified by the Contractor will be numerically tracked using QC punch list items. The Contractor shall maintain a current log of its QC punch list items in the QCS database. The Government will log the deficiencies it has identified using its QA punch list items. The Government's QA punch list items will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of both QC and QA punch list items.

1.6.3.3 Three-Phase Control Meetings

The Contractor shall maintain scheduled and actual dates and times of preparatory and initial control meetings in QCS.

1.6.3.4 Accident/Safety Tracking.

The Government will issue safety comments, directions, or guidance whenever safety deficiencies are observed. The Government's safety comments will be included in its export file to the Contractor. The Contractor shall regularly update the correction status of the safety comments. In addition, the Contractor shall utilize QCS to advise the Government of any accidents occurring on the jobsite. This brief supplemental entry is not to be considered as a substitute for completion of mandatory reports, e.g., ENG Form 3394 and OSHA Form 200.

1.6.3.5 Features of Work

The Contractor shall include a complete list of the features of work in the QCS database. A feature of work may be associated with multiple pay activities. However, each pay activity (see subparagraph "Pay Activity Data" of paragraph "Finances") will only be linked to a single feature of work.

1.6.3.6 QC Requirements

The Contractor shall develop and maintain a complete list of QC testing, transferred and installed property, and user training requirements in QCS. The Contractor shall update all data on these QC requirements as work progresses, and shall promptly provide this information to the Government via QCS.

1.6.4 Submittal Management

The Contractor will provide the initial submittal register, ENG Form 4288, SUBMITTAL REGISTER in electronic format. Thereafter, the Contractor shall maintain a complete list of all submittals, including completion of all data columns. Dates on which submittals are received and returned by the Government will be included in its export file to the Contractor. The Contractor shall use QCS to track and transmit all submittals. ENG Form 4025, submittal

transmittal form, and the submittal register update, ENG Form 4288, shall be produced using QCS. RMS will be used to update, store and exchange submittal registers and transmittals, but will not be used for storage of actual submittals.

1.6.5 Schedule

The Contractor shall develop a construction schedule consisting of pay activities, in accordance with Contract Clause "Schedules for Construction Contracts", or Section 01320, PROJECT SCHEDULE, as applicable. This schedule shall be input and maintained in the QCS database either manually or by using the Standard Data Exchange Format (SDEF) (see Section 01320, PROJECT SCHEDULE). The updated schedule data shall be included with each pay request submitted by the Contractor.

1.6.6 Import/Export of Data

QCS includes the ability to export Contractor data to the Government and to import submittal register and other Government-provided data, and schedule data using SDEF.

1.7 IMPLEMENTATION

Contractor use of QCS as described in the preceding paragraphs is mandatory. The Contractor shall ensure that sufficient resources are available to maintain its QCS database, and to provide the Government with regular database updates. QCS shall be an integral part of the Contractor's management of quality control.

1.8 DATA SUBMISSION VIA COMPUTER DISKETTE OR CD-ROM

The Government-preferred method for Contractor's submission of updates, payment requests, correspondence and other data is by E-mail with file attachment(s). For locations where this is not feasible, the Contracting Officer may permit use of computer diskettes or CD-ROM for data transfer. Data on the disks or CDs shall be exported using the QCS built-in export function. If used, diskettes and CD-ROMs will be submitted in accordance with the following:

1.8.1 File Medium

The Contractor shall submit required data on 3-1/2 inch double-sided high-density diskettes formatted to hold 1.44 MB of data, capable of running under Microsoft Windows 95 or newer. Alternatively, CD-ROMs may be used. They shall conform to industry standards used in the United States. All data shall be provided in English.

1.8.2 Disk or CD-ROM Labels

The Contractor shall affix a permanent exterior label to each diskette and CD-ROM submitted. The label shall indicate in English, the QCS file name, full contract number, contract name, project location, data date, name and telephone number of person responsible for the data.

1.8.3 File Names

The Government will provide the file names to be used by the Contractor with the QCS software.

1.9 MONTHLY COORDINATION MEETING

The Contractor shall update the QCS database each workday. At least monthly, the Contractor shall generate and submit an export file to the Government with schedule update and progress payment request. As required in Contract Clause "Payments", at least one week prior to submittal, the Contractor shall meet with the Government representative to review the planned progress payment data submission for errors and omissions. The Contractor shall make all required corrections prior to Government acceptance of the export file and progress payment request. Payment requests accompanied by incomplete or incorrect data submittals will be returned. The Government will not process progress payments until an acceptable QCS export file is received.

1.10 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the requirements of this specification. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification.

END OF SECTION

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SECTION 01320
PROJECT SCHEDULE

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTALS:

SD-07 Schedules

GA Preliminary project schedule, two (2) copies.

GA initial project schedule, two (2) copies
Activity No. Sort
Predecessor/successor listing
Cost Schedule
Floppy Disk with schedule data in Standard Data Exchange Format (SDEF).
Activity Code Dictionary.

FIO Periodic schedules updates, monthly updates two (2) copies.
Floppy Disks with schedule data in Standard Data Exchange Format (SDEF).
Narrative
Activity No. Sort
Cost Schedule
Cash Flow Report (S-Curve)

SD-08 Statements

Qualifications; GA .

Documentation showing qualifications of personnel preparing schedule reports.

1.2 QUALIFICATIONS

The Contractor shall designate an authorized representative who shall be responsible for the preparation of all required project schedule reports. This person shall have previously created and reviewed computerized schedules. Qualifications of this individual shall be submitted to the Contracting Officer for review with the Preliminary Project Schedule submission.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Pursuant to the Contract Clause, SCHEDULE FOR CONSTRUCTION CONTRACTS a Project Schedule as described below shall be prepared. The scheduling of construction shall be the responsibility of the Contractor. Contractor management personnel shall actively participate in its development. Subcontractors and suppliers working on the project should also contribute in developing and maintaining an accurate Project Schedule. The approved Project Schedule shall be used to measure the progress of the work, to aid in evaluating time extensions, and to provide the basis of all progress payments.

3.2 BASIS FOR PAYMENT

The schedule shall be the basis for measuring Contractor progress. Lack of an approved schedule or scheduling personnel shall result in an inability of the Contracting Officer to evaluate Contractor progress for the purposes of payment. Failure of the Contractor to provide all information, as specified below, shall result in the disapproval of the entire Project Schedule submission and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes. In the case where Project Schedule revisions have been directed by the Contracting Officer and those revisions have not been included in the Project Schedule, then the Contracting Officer may hold retainage up to the maximum allowed by contract, each payment period, until revisions to the Project Schedule have been made.

3.3 PROJECT SCHEDULE

The computer software system utilized by the Contractor to produce the Project Schedule shall be capable of providing all requirements of this specification including the SDEF (Standard Data Exchange Format). Failure of the Contractor to meet the requirements of this specification shall result in the disapproval of the schedule. Manual methods used to produce any required information shall require approval by the Contracting Officer.

3.3.1 Use of the Critical Path Method

The Critical Path Method (CPM) of network calculation shall be used to generate the Project Schedule. The Contractor shall provide the Project Schedule in Precedence Diagram Method (PDM)

3.3.2 Level of Detail Required

With the exception of the initial and preliminary schedule submission, the Project Schedule shall include an appropriate level of detail. Failure to develop or update the Project Schedule or provide data to the Contracting Officer at the appropriate level of detail, as specified by the Contracting Officer, shall result in the disapproval of the schedule. The Contracting Officer will use, but is not limited to, the following conditions to determine the appropriate level of detail to be used in the Project Schedule.

3.3.2.1 Activity Durations

Contractor submissions shall be required to follow the direction of the Contracting Officer regarding reasonable activity durations. Reasonable durations are those that allow the progress of activities to be accurately determined between payment periods. A rule of thumb, that the Contractor should use, is that less than 2 percent of all non-procurement activities' Original Durations shall be greater than 20 days.

3.3.2.2 Procurement Activities

Tasks related to the procurement of long lead materials or equipment shall be included as separate activities in the project schedule. Long lead materials and equipment are those materials that have a procurement cycle of over 90 days. Examples of procurement process activities include, but are not limited to: submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing.

3.3.2.3 Government Activities

Government and other agencies activities that could impact progress shall be shown. These activities include, but are not limited to: approvals, inspections, utility tie-in, Government Furnished Equipment (GFE) and notice to proceed for phasing requirements.

3.3.2.4 Responsibility

All activities shall be identified in the project schedule by the party responsible to perform the work. Responsibility includes, but is not limited to, the subcontracting firm, (at the lowest tier), Contractor work force, or Government agency performing a given task. Activities shall not belong to more than one responsible party. The responsible party for each activity shall be identified by the Responsibility Code.

3.3.2.5 Work Areas

All activities shall be identified in the project schedule by the work area in which the activity occurs. Activities shall not be allowed to cover more than one work area. The work area of each activity shall be identified by the Work Area Code.

3.3.2.6 Modification or Claim Number

Any activity that is added or changed by contract modification or used to justify claimed time shall be identified by a mod or claim code that changed the activity. Activities shall not belong to more than one modification or claim item. The modification or claim number of each activity shall be identified by the Mod or Claim Number. Whenever possible, changes shall be added to the schedule by adding new activities. Existing activities shall not normally be changed to reflect modifications.

3.3.2.7 Bid Item

All activities shall be identified in the project schedule by the Bid Item to which the activity belongs. An activity shall not contain work in more than one bid item. The bid item for each appropriate activity shall be identified by the Bid Item Code.

3.3.2.8 Phase of Work

All activities shall be identified in project schedule by phases of work in which the activity occurs. Activities shall not contain work in more than one phase of work. The project phase of each activity shall be by the unique Phase of Work Code.

3.3.2.9 Category of Work

All Activities shall be identified in the project schedule according to the category of work which best describes the activity. Category of work refers, but is not limited to, to the procurement chain of activities including such items as submittals, approvals, procurement, fabrication, delivery, installation, start-up, and testing. The category of work for each activity shall be identified by the Category of Work Code.

3.3.2.10 Feature of Work

All activities shall be identified in the project schedule according to the feature of work to which the activity belongs. Feature of work refers, but is not limited to a work breakdown structure for the project. The feature of work for each activity shall be identified by the Feature of Work Code.

3.3.2.11 Critical Activities

The following activities shall be listed as separate line activities on a Contractor's project schedule:

- ?? Submission and approval of mechanical/electric layout drawings
- ?? Submission and approval of O&M manuals
- ?? Submission and approval of as-built drawings
- ?? Submission and approval of 1354 data and installed equipment lists
- ?? Submission and approval of testing and air balance (TAB) firm
- ?? Submission of TAB specialist design review report
- ?? Submission and approval of fire protection specialist
- ?? Submission and approval of testing and balancing and HVAC commissioning plans and data
- ?? Air and water balance dates
- ?? HVAC commissioning dates
- ?? Controls testing plan
- ?? Controls testing
- ?? Performance Verification testing
- ?? Other systems testing, if required
- ?? Prefinal inspection
- ?? Correction of punchlist from prefinal inspection
- ?? Final inspection

3.3.3 Scheduled Project Completion

The schedule interval shall extend from notice-to-proceed to the contract completion date.

3.3.3.1 Project Start Date

The schedule shall start no earlier than the date that the Notice to Proceed (NTP) was acknowledged. The Contractor shall include as the first activity in the project schedule an activity called "Start Project". The "Start Project" activity shall have: a "ES" constraint, a constraint date equal to the date that the NTP was acknowledged, and a zero day duration.

3.3.3.2 Constraint of Last Activity

Completion of the last activity in the schedule shall be constrained by the contract completion date. Calculation on project updates shall be such that if the early finish of the last activity falls after the contract completion date, then the float calculation shall reflect a negative float on the critical path. The Contractor shall include as the last activity in the project schedule an activity call "End Project". The "End Project" activity shall have: a "LF" constraint, a constraint date equal to the completion date for the project, and a zero day duration.

3.3.3.3 Early Project Completion

In the event the project schedule shows completion of the project prior to the contract completion date, the Contractor shall identify those activities that have been accelerated and/or those activities that are scheduled in parallel to support the Contractor's "early" completion. Contractor shall specifically address each of the activities noted at every project schedule update period to assist the Contracting Officer to evaluate the Contractor's ability to actually complete prior to the contract period.

3.3.4 Interim Completion Dates

Contractually specified interim completion dates shall also be constrained to show negative float if the early finish date of the last activity in that phase falls after the interim completion date.

3.3.4.1 Start Phase

The Contractor shall include as the first activity for a project phase an activity called "Start Phase X" where "X" refers to the phase of work. "Start Phase X" activity shall have an "ES" constraint date equal to the date on which the NTP was acknowledged, and a zero day duration.

3.3.4.2 End Phase

The Contractor shall include as the last activity in a project phase an activity called "End Phase X" where "X" refers to the phase of work. The "End Phase X" activity shall have an "LF" constraint date equal to the completion date for the project, and a zero day duration.

3.3.4.3 Phase X

The Contractor shall include a hammock type activity for each project phase called "Phase X" where "X" refers to the phase of work. The "Phase X" activity shall be logically tied to the earliest and latest activities in the phase.

3.3.5 Default Progress Data Disallowed

Actual Start and Finish dates shall not be automatically updated by default mechanisms that may be included in CPM scheduling software systems. Actual Start and Finish dates on the CPM schedule shall match those dates provided from Contractor Quality Control Reports. Failure of the Contractor to document the Actual Start and Finish dates on the Daily Quality Control report for every in progress or completed activity and ensure that the data contained on the Daily Quality Control reports is the sole basis for schedule updating shall result in the disapproval of the Contractor's schedule and the inability of the Contracting Officer to evaluate Contractor progress for payment purposes.

3.3.6 Out-of-Sequence Progress

Activities that have posted progress without predecessors being completed (Out-of-Sequence Progress) shall be allowed only by the case-by-case approval of the Contracting Officer. The Contracting Officer may direct that changes in schedule logic be made to correct any or all out-of-sequence work.

3.3.7 Negative Lags

Lag durations contained in the project schedule shall not have a negative value.

3.4 PROJECT SCHEDULE SUBMISSIONS

The Contractor shall provide the submissions as described below. The data disk, reports, and network diagrams required for each submission are contained in paragraph SUBMISSION REQUIREMENTS.

3.4.1 Preliminary Project Schedule Submission

The Preliminary Project Schedule, defining the Contractor's planned operations for the first 60 calendar days shall be submitted for approval within 10 calendar days after Notice to Proceed is acknowledged. The approved preliminary schedule shall be used for payment purposes not to exceed 60 calendar days after Notice to Proceed.

3.4.2 Initial Project Schedule Submission

The Initial Project Schedule shall be submitted for approval within 40 calendar days after Notice to Proceed. The schedule shall provide a reasonable sequence of activities which represent work through the entire project and shall be at a reasonable level of detail.

3.4.3 Periodic Schedule Updates

Based on the result of progress meetings, specified in "Periodic Progress Meetings," the Contractor shall submit periodic schedule updates. These submissions shall enable the Contracting Officer or to assess Contractor's progress. If the Contractor fails or refuses to furnish the information and project schedule data, which in the judgment of the Contracting Officer or authorized representative, is necessary for verifying the contractor's progress, the Contractor shall be deemed not to have provided an estimate upon which progress payment may be made.

3.4.4 Standard Activity Coding Dictionary

The Contractor shall submit, with the Initial Project Schedule, a coding scheme that shall be used throughout the project for all activity codes contained in the schedule. The coding scheme submitted shall list the values for each activity code category and translate those values into project specific designations. For example, a Responsibility Code Value, "ELE", may be identified as "Electrical Subcontractor." Activity code values shall represent the same information throughout the duration of the contract. Once approved with the Initial Project Schedule submission, changes to the activity coding scheme must be approved by the Contracting Officer.

3.5 SUBMISSION REQUIREMENTS

The as noted in paragraph 1.1 items shall be submitted by the Contractor for the preliminary submission, initial submission, and every periodic project schedule update throughout the life of the project:

3.5.1 Data Disks

Two data disks containing the project schedule shall be provided. Data on the disks adhere to the SDEF format specified in ER 1-1-11, Appendix A.

3.5.1.1 File Medium

Required data shall be submitted on 89 mm (3.5 inch) disks, formatted to hold 1.44 MB of data.

3.5.1.2 Disk Label

A permanent exterior label shall be affixed to each disk submitted. The label shall indicate the type of schedule (Initial, Update, or Change), full contract number, project name, project location, data date, name and telephone number or person responsible for the schedule, and the version used to prepare the C.P.M.

3.5.1.3 File Name

Each file submitted shall have a name related to either the schedule data date, project name, or contract number. The Contractor shall develop a naming convention that will ensure that the names of the files submitted are unique. The Contractor shall submit the file naming convention to the Contracting Officer for approval.

3.5.2 Narrative Report

A Narrative Report shall be provided with each update of the project schedule. This report shall be provided as the basis of the Contractor's progress payment request. The Narrative Report shall include: a description of activities along the critical path, a description of current and anticipated problem areas or delaying factors and their impact, and an explanation of corrective actions taken or required to be taken. The narrative report is expected to relay to the Government, the Contractor's thorough analysis of the schedule output and its plans to

compensate for any problems, either current or potential, which are revealed through that analysis.

3.5.3 Approved Changes Verification

Only project schedule changes that have been previously approved by the Contracting Officer shall be included in the schedule submission. The Narrative Report shall specifically reference, on an activity by activity basis, all changes made since the previous period and relate each change to documented, approved schedule changes.

3.5.4 Schedule Reports

The format for each activity for the schedule reports listed below shall contain: Activity Numbers, Activity Description, Original Duration, Remaining Duration, Early Start Date, Early Finish Date, Late Start Date, Late Finish Date, Total Float. Actual Start and Actual Finish Dates shall be printed for those activities in-progress or completed.

3.5.4.1 Activity Report

A list of all activities sorted according to activity number. For completed activities the Actual Start Date shall be used as the secondary sort.

3.5.4.2 Logic Report

A list of Preceding and Succeeding activities for every activity in ascending order by activity number and then sorted according to Early Start Date. For completed activities the Actual Start Date shall be used as the secondary sort. Preceding and succeeding activities shall include all information listed above in paragraph Schedule Reports. A blank line shall be left between each activity grouping.

3.5.4.3 Total Float Report

A list of all activities sorted in ascending order of total float. Activities which have the same amount of total float shall be listed in ascending order of Early Start Dates. Completed activities shall not be shown on this report.

3.5.4.4 Earnings Report

A compilation of the Contractor's Total Earnings on the project from the Notice to Proceed until the most recent Monthly Progress Meeting. This report shall reflect the Earnings of specific activities based on the agreements made in the field and approved between the Contractor and Contracting Officer at the most recent Monthly Progress Meeting. Provided that the Contractor has provided a complete schedule update, this report shall serve as the basis of determining Contractor Payment. Activities shall be grouped by bid item and sorted by activity numbers. This report shall: sum all activities in a bid item and provide a bid item percent; complete and sum all bid items to provide a total project percent complete. The printed report shall contain, for each activity: Activity Number, Activity Description, Original Budgeted Amount, Total Quantity, Quantity to Date, Percent Complete (based on cost), Earnings to Date.

3.5.4.5 Cash Flow Report

A report showing scheduled cost of work-in-place by week (tabular report) and a cash flow curve by week (S-curve plot), both based on early dates.

3.5.5 Network Diagram

The time scaled network diagram shall be required on the initial schedule submission and on quarterly update submissions. The network diagram shall depict and display the order and interdependence of activities and the sequence in which the work is to be accomplished. The Contracting Officer will use, but is not limited to, the following conditions to review compliance with this paragraph:

3.5.5.1 Continuous Flow

Diagrams shall show a continuous flow from left to right with no arrows from right to left. The activity or event number, description, duration, and estimated earned value shall be shown on the diagram.

3.5.5.2 Project Milestone Dates

Dates shall be shown on the diagram for start of project, any contract required interim completion dates, and contract completion dates.

3.5.5.3 Critical Path

The critical path shall be clearly shown.

3.5.5.4 Banding

Activities shall be grouped to assist in the understanding of the activity sequence. Typically, this flow will group activities by category of work, work area and/or responsibility.

3.5.5.5 S-Curves

Earnings curves shall be provided showing projected early and late earnings and earnings to date.

3.6 PERIODIC PROGRESS MEETINGS

Progress meetings to discuss payment shall include a monthly on-site meeting or other regular intervals mutually agreed to at the preconstruction conference. During this meeting the Contractor will describe, on an activity by activity basis, all proposed revisions and adjustments to the project schedule required to reflect the current status of the project. The Contracting Officer will approve activity progress, proposed revisions, and adjustments as appropriate.

3.6.1 Meeting Attendance

The Contractor's Project Manager and Scheduler shall attend the regular progress meeting.

3.6.2 Update Submission Following Progress Meeting

A complete update of the project schedule containing all approved progress, revisions, and adjustments, based on the regular progress meeting, shall be submitted not later than 4 working days after the monthly progress meeting.

3.6.3 Progress Meeting Contents

Update information, including Actual Start Dates, Actual Finish Dates, Remaining Durations, and Cost to Date shall be subject to the approval of the Contracting Officer. The following minimum set of items which the Contractor shall address, on an activity by activity basis, during each progress meeting.

3.6.3.1 Start and Finish Dates

The Actual Start and Actual Finish dates for each activity currently in-progress or completed activities.

3.6.3.2 Time Completion

The estimated Remaining Duration for each activity in-progress. Time-based progress calculations must be based on Remaining Duration for each activity.

3.6.3.3 Cost Completion

The earnings for each activity started. Payment shall be based on earnings for each in-progress or completed activity. Payment for individual activities shall not be made for work that contains quality defects. A portion of the overall project amount may be retained based on delays of activities.

3.6.3.4 Logic Changes

All logic changes pertaining to Notice to Proceed on change orders, change orders to be incorporated into the schedule, contractor proposed changes in work sequence, corrections to schedule logic for out-of-sequence progress, lag durations, and other changes that have been made pursuant to contract provisions shall be specifically identified and discussed.

3.6.3.5 Other Changes

Other changes required due to delays in completion of any activity or group of activities are those delays beyond the Contractors control such as strikes and unusual weather. Also included are delays encountered due to submittals, Government Activities, deliveries or work stoppage which makes re-planning the work necessary, and when the schedule does not represent the actual prosecution and progress of the work.

3.7 REQUESTS FOR TIME EXTENSIONS

In the event the Contractor requests an extension of the contract completion date, he shall furnish such justification, project schedule data and supporting evidence as the Contracting Officer may deem necessary for a determination as to whether or not the Contractor is entitled

to an extension of time under the provisions of the contract. Submission of proof of delay, based on revised activity logic, duration, and costs (updated to the specific date that the delay occurred) is obligatory to any approvals.

3.7.1 Justification of Delay

The project schedule must clearly display that the Contractor has used, in full, all the float time available for the work involved with this request. The Contracting Officer's determination as to the number of allowable days of contract extension, shall be based upon the project schedule updates in effect for the time period in question and other factual information. Actual delays that are found to be caused by the Contractor's own actions, which result in the extension of the schedule, shall not be a cause for a time extension to the contract completion date.

3.7.2 Submission Requirements

The Contractor shall submit a justification for each request for a change in the contract completion date of under two weeks based upon the most recent schedule update at the time of the Notice to Proceed or constructive direction issued for the change. Such a request shall be in accordance with the requirements of other appropriate Contract Clauses and shall include, as a minimum:

- a. A list of affected activities, with their associated project schedule activity number.
- b. A brief explanation of the causes of the change.
- c. An analysis of the overall impact of the changes proposed.
- d. A sub-network of the affected area.

Activities impacted in each justification for change shall be identified by a unique activity code contained in the required data file.

3.7.3 Additional Submission Requirements

For any request for time extension for over 2 weeks, the Contracting Officer may request an interim update with revised activities for a specific change request. The Contractor shall provide this disk within 4 days of the Contracting Officer's request.

3.8 DIRECTED CHANGES

If Notice to Proceed (NTP) is issued for changes prior to settlement of price and/or time, the Contractor shall submit proposed schedule revisions to the Contracting Officer within 2 weeks of the NTP being issued. The proposed revisions to the schedule will be approved by the Contracting Officer prior to inclusion of those changes within the project schedule. If the Contractor fails to submit the proposed revisions, the Contracting Officer may furnish the Contractor suggested revisions to the project schedule. The Contractor shall include these revisions in the project schedule until the Contractor submits revisions, and final changes and impacts have been negotiated. If the Contractor has any objections to the revisions furnished by the Contracting Officer, then the Contractor shall advise the Contracting Officer within 2 weeks of receipt of the revisions. Regardless of the objections, the Contractor will continue to

update their schedule with the Contracting Officer's revisions until a mutual agreement in the revisions may be made. If the Contractor fails to submit alternative revisions within 2 weeks of receipt of the Contracting Officer's proposed revisions, the Contractor will be deemed to have concurred with the Contracting Officer's proposed revisions. The proposed revisions will then be the basis for an equitable adjustment for performance of the work.

3.9 OWNERSHIP OF FLOAT

Float available in the schedule, at any time, shall not be considered for the exclusive use of either the Government or the Contractor.

3.10 NAS DATA

The Contractor shall provide the Government with the means to electronically transfer all required NAS data into the Resident Management System (RMS) program using the Standard Data Exchange Format (SDEF). The Contractor may use network analysis software different from that used by the Contracting Officer in the Resident Office, however, the Contractor shall also furnish the following:

NAS data that complies with the Standard Data Exchange Format (SDEF). This is a standard ASCII format for exchanging scheduling data and is compatible with our resident management system. Many software developers provide the capability to convert and export schedule data to the SDEF at no additional cost. The SDEF specifications are in a separate publication, available from the Internet WWW.CECER.AARMY.MIL/PL/SDEF.

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 CONTROL AND SCHEDULING OF SUBMITTALS

1.1.1 Submittal Coordination Meeting

During the preconstruction safety conference with the COR, the Contractor shall provide and develop an approved preliminary submittal register, ENG Form 4288. During the meeting all required items will be identified and grouped into three categories:

?? Government Approved (GA)

Government approval is required for extensions of design, critical materials, variations/deviations, an "or equal" decision, equipment whose compatibility with the entire system must be checked, architectural items such as Color Charts/Patterns/Textures, and other items as designated by the COR. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," these submittals will be acted on as "shop drawings."

?? For Information Only (FIO)

Submittals not requiring Government approval will be for information only. These are items such as Installation Procedures, Certificates of compliance, Samples, Qualifications, etc. Within the terms of the Contract Clause entitled "Specifications and Drawings for Construction," these submittals will not be acted on as "shop drawings."

?? Those items that can be visually inspected by the Contractor's Quality Control Representative (CQC) on site or are provided to the Government other than with an ENG Form 4025: The items that fall into this category shall remain on the register but shall not be submitted to the COR. For these items, the "Classification" column on the submittal register shall remain blank.

1.1.2 Final Submittal Register

The final submittal register shall be coordinated with the progress schedule and submitted within 40 days of Notice to Proceed. In preparing the final document, adequate time (minimum of 30 days) shall be allowed for review and approval, and possible resubmittal of each item on the register.

1.1.3 Submittal Register Updates

The Contractor's quality control representative shall review the listing at least every 30 days and take appropriate action to maintain an effective system. Copies of updated or corrected listings shall be submitted to the COR at least every 30 days in the quantity specified.

1.2 SUBMITTAL TYPES

Throughout these specifications submittals may be identified with the prefix "SD" (submittal data) followed by a number (category, i.e., data, drawings, reports, etc.). This is for bookkeeping and record sorting in the system:

Data

Submittals which provide calculations, descriptions, or documentation regarding the work.

Drawings

Submittals which graphically show relationship of various components of the work, schematic diagrams of systems, details of fabrication, layouts of particular elements, connections, and other relational aspects of the work.

Instructions

Preprinted material describing installation of a product, system or material, including special notices and material safety data sheets, if any, concerning impedances, hazards, and safety precautions.

Schedules

Tabular lists showing location, features, or other pertinent information regarding products, materials, equipment, or components to be used in the work.

Statements

A document, required of the Contractor, or through the Contractor from a subcontractor, supplier, installer, or manufacturer to confirm the quality or orderly progression of a portion of the work by documenting procedures, acceptability of methods or personnel, qualifications, or other quality verifications.

Reports

Reports of inspections or tests, including analyses and interpretation of test results. Each report shall be properly identified. Test methods used shall be identified and test results shall be recorded.

Certificates

Statement signed by an official authorized to certify on behalf of the manufacturer that a product, system or material meets specified requirements. The statement must be dated after the award of this contract and state the Contractor's name and address, project and location, and list specific requirements which are being certified.

Samples

Fabricated and/or unfabricated physical examples of materials, products, and/or units of work as complete units or as portions of units.

Records

Documentation to record compliance with technical or administrative requirements.

Operation and Maintenance Manuals

Data which forms a part of an operation and maintenance manual.

Submittals required by the Contract Clauses and other non-technical parts of the contract are not necessarily included in this section. These type of submittals can be added to the register before or during the submittal coordination meeting.

1.3 APPROVED SUBMITTALS

The approval of submittals by the COR shall not be construed as a complete check, but will indicate only that the general method of construction, materials, detailing and other information are satisfactory. Approval will not relieve the Contractor of the responsibility for any error which may exist. The Contractor, under the CQC requirements of this contract, is responsible for the dimensions and design of adequate connections, details, and satisfactory construction of all work. After submittals have been approved by the COR, no resubmittal for the purpose of substituting materials or equipment will be given consideration.

1.4 DISAPPROVED SUBMITTALS

The Contractor shall make all corrections required by the COR and promptly furnish a corrected submittal in the format and number of copies specified for the initial submittal. If the Contractor considers any correction indicated on the submittals to constitute a change to the contract, written notice, as required under the Contract Clause entitled "Changes," shall be given to the COR.

1.5 PAYMENT

Separate payment will not be made for submittals, and all costs associated therein shall be included in the applicable unit prices or lump sum prices contained in the schedule. Payment will not be made for any material or equipment which does not comply with contract requirements.

PART 2 PRODUCTS (Not Applicable)

PART 3 EXECUTION

3.1 GENERAL

Prior to submittal, all items shall be checked and approved by the Contractor's CQC and each item of the submittal shall be stamped, signed, and dated. Each respective transmittal form (ENG Form 4025) shall be signed and dated by the CQC certifying that the accompanying submittal complies with the contract requirements. This procedure applies to all submittals. Submittals shall include items such as: Contractor's, manufacturer's, or fabricator's drawings; descriptive literature including, but not limited to, catalog cuts, diagrams; operating charts or curves; test reports; test cylinders; samples; O&M manuals including parts lists; certifications; warranties and other such required items. Units of weights and measures used on all

submittals shall be the same as the contract drawings. Each submittal shall be complete and in sufficient detail to allow ready determination of compliance with contract requirements. GA submittals shall be scheduled and made prior to the acquisition of the material or equipment covered thereby. The COR may request submittals in addition to those listed when deemed necessary to adequately describe the work covered in the respective sections. The Contractor shall maintain a complete and up-to-date file of all submittals/items on site for use by both the Contractor and the Government.

3.2 SUBMITTAL REGISTER (ENG Form 4288)

The submittal register - ENG Form 4288 – for Divisions 1 through 16 shall be developed by the Contractor prior to the submittal coordination meeting and list each item of equipment and material for which submittals are required in the Technical Specifications. (See paragraph SUBMITTALS at the beginning of each specification section. A blank form ENG 4288 is attached at the end of this specification section.) The Contractor shall approve all items listed on the submittal register. During the submittal coordination meeting, a preliminary submittal register will be created by annotating this Form 4288. When the final submittal register is submitted for approval, the Contractor shall complete the column entitled "Item No." and all data under "Contractor Schedule Dates" and return five completed copies to the COR for approval. The Contractor shall review the list to ensure its completeness and may expand general category listings to show individual entries for each item. The numbers in column "Item No." are to be assigned sequentially starting with "1" for each specification section. DO NOT preassign transmittal numbers when preparing the submittal register. When a conflict exists between the submittal register and a submittal requirement in the technical sections, other than those submittals referenced in Paragraph 3.9: Field Test Reports, the approved submittal register shall govern. The preliminary, and then the final approved submittal register, will become the scheduling documents and will be updated monthly and used to control submittals throughout the life of the contract. Names and titles of individuals authorized by the Contractor to approve shop drawings shall be submitted to COR with the final 4288 form. Supplier or subcontractors certifications are not acceptable as meeting this requirement.

3.3 SCHEDULING

Submittals covering component items forming a system, or items that are interrelated, shall be coordinated and submitted concurrently. Certifications shall be submitted together with other pertinent information and/or drawings. Additional processing time beyond 30 days, or number of copies, may be shown by the COR on the submittal register attached in the "Remarks" column, or may be added by the COR during the coordination meeting. No delays damages or time extensions will be allowed for time lost due to the Contractor not properly scheduling and providing submittals.

3.4 TRANSMITTAL FORM (ENG Form 4025)

Transmittal Form 4025 (sample at end of this section) shall be used for submitting both GA and FIO submittals in accordance with the instructions on the reverse side of the form. Transmittal numbers shall be assigned sequentially. Electronic generated 4025 forms shall be printed on carbonless paper and be a reasonable facsimile of the original 4025. If electronic forms are not used, the original 4025 forms shall be used (do not photo copy) and will be furnished by the COR. These forms shall be filled in completely prior to submittal. Special care shall be exercised to ensure proper listing of the specification paragraph and/or sheet number of the contract drawings pertinent to the data submitted for each item.. Each submittal item shall be

listed separately on the form, naming subcontractor, supplier, or manufacturer, applicable specification paragraph number(s), drawing/sheet number, pay item number, and any other information needed to identify the item, define its use, and locate it in the work. One or more 4025 forms may be used per specification section, however, DO NOT include more than one specification section per transmittal.

3.5 CROSS-REFERENCE (ENG FORM 4288/ENG FORM 4025)

To provide a cross-reference between the approved submittal register and transmittal forms, the Contractor shall record the "transmittal numbers" assigned when submitting items in column "Transmittal No." of the ENG FORM 4288. The item numbers in column "Item No." of submittal register shall correspond to the item numbers on ENG Form 4025.

3.6 SUBMITTAL PROCEDURE

3.6.1 General

Shop drawings with 4025 forms shall be submitted in the number of copies specified in subparagraphs "Government Approved Submittals" and "Information Only Submittals," or as indicated on the submittal register in the "Remarks" column. Submit a complete collated "reviewers copy" with one 4025 form and attachments (not originals). The remaining copies (4 for GA, 2 for FIO) of 4025 forms and attachments shall not be collated. This would not apply to a series of drawings.

3.6.2 Approval of Submittals by the Contractor

Before submittal to the COR, the Contractor shall review and correct shop drawings prepared by subcontractors, suppliers, and itself, for completeness and compliance with plans and specifications. The Contractor shall not use red markings for correcting material to be submitted. Red markings are reserved for COR's use. Approval by the Contractor shall be indicated on each shop drawing by an approval stamp containing information as shown in this section. Submittals not conforming to the requirements of this section will be returned to the Contractor for correction and resubmittal.

3.6.3 Variations

For submittals which include proposed variations requested by the Contractor, column "h" of ENG Form 4025 shall be checked and the submittal shall be classified as GA, and submitted accordingly. The Contractor shall set forth in writing the justification for any variations and annotate such variations on the transmittal form in the REMARKS block. Variations are not approved unless there is an advantage to the Government. The Government reserves the right to rescind inadvertent approval of submittals containing unnoted variations.

3.6.4 Drawings

Each drawing shall be not larger than A1 size (841 mm wide by 594 mm high), with a title block in lower right hand corner and a 75 mm by 100 mm (3 by 4 inch) clear area adjacent. The title block shall contain the subcontractor's or fabricator's name, contract number, description of item(s), bid item number, and a revision block. Provide a blank margin of 20 mm (3/4 inch) at bottom, 50 mm (2 inches) at left, and 10 mm (1/2 inch) at top and right. Where drawings are submitted for assemblies of more than one piece of equipment or systems of components

dependent on each other for compatible characteristics, complete information shall be submitted on all such related components at the same time. The Contractor shall ensure that information is complete and that sequence of drawing submittal is such that all information is available for reviewing each drawing. Drawings for all items and equipment, of special manufacture or fabrication, shall consist of complete assembly and detail drawings. All revisions after initial submittal shall be shown by number, date, and subject in revision block.

3.6.4.1 Submittals Containing Drawings Larger than A3 size (297 mm high by 420 mm wide)

For GA submittals containing drawings larger than A3 size, one reproducible and one blue line copy will be required to be submitted with five copies of the ENG Form 4025. The marked-up reproducible (and/or any review comments contained on the page-size comment sheet(s) at the Government's option) will be returned to the Contractor upon review. The Contractor shall provide three copies of blue line drawings (generated from the reviewed reproducible) to the Government within 10 days of Contractor's receipt of the reviewed reproducible. The Contractor shall not incorporate approved work into the project until the Government has received the three blue line copies. The Contractor shall use the marked-up reproducible to make any additional copies as needed. For FIO submittals, one reproducible and two blue line copies shall be submitted with the appropriate number of copies of ENG Form 4025.

3.6.5 Printed Material

All requirements for shop drawings shall apply to catalog cuts, illustrations, printed specifications, or other data submitted, except that the 75 mm by 100 mm (3 inch by 4 inch) clear area adjacent to the title block is not mandatory. Inapplicable portions shall be marked out and applicable items such as model numbers, sizes, and accessories shall be indicated by arrow or highlighted.

3.7 SAMPLES REQUIRING LABORATORY ANALYSIS

See Section 01451 CONTRACTOR QUALITY CONTROL for procedures and address for samples requiring Government testing.

3.8 SAMPLES REQUIRING VISUAL INSPECTION

Samples requiring only physical inspection for appearance and suitability shall be coordinated with the on-site Government quality assurance representative (QAR).

3.9 FIELD TEST REPORTS

Routine tests such as soil density, concrete deliveries, repetitive pressure testing shall be delivered to the QAR with the daily Quality Control reports. See SECTION: 01451 CONTRACTOR QUALITY CONTROL.

3.10 CONTROL OF SUBMITTALS

The Contractor shall carefully control his procurement operations to ensure that each individual submittal is made on or before the Contractor scheduled submittal date shown on the approved "Submittal Register."

3.11 GOVERNMENT APPROVED SUBMITTALS (GA)

The Contractor shall submit 5 copies of GA submittals with 5 corresponding 4025 forms. Upon completion of GA submittal review, copies as specified below will be marked with an action code, dated, and returned to the Contractor. See "Drawings" above for special instructions if drawings larger than size A3 are used.

3.11.1 Processing of GA Submittals

Submittals will be reviewed and processed as follows:

a. Approved as Submitted (Action Code "A"): Shop drawings which can be approved without correction will be stamped "Approved" and two copies will be returned to the Contractor. No resubmittal required.

b. Approved Except as Noted (Action Code "B"): Shop drawings which have only minor discrepancies will be annotated in red to indicate necessary corrections. Marked material will be stamped "Approved Except as Noted" and two copies returned to the Contractor for correction. No resubmittal required.

c. Approved Except as Noted (Action Code "C"): Shop drawings which are incomplete or require more than minor corrections will be annotated in red to indicate necessary corrections. Marked material will be stamped "Approved Except as Noted - Resubmission Required" and two copies returned to the Contractor for correction. Resubmittal of only those items needing correction required.

d. Disapproved (Action Code "E"): Shop drawings which are fundamentally in error, cover wrong equipment or construction, or require extensive corrections, will be returned to the Contractor stamped "Disapproved." An explanation will be furnished on the submitted material or on ENG Form 4025 indicating reason for disapproval. Complete resubmittal required.

e. Resubmittal will not be required for shop drawings stamped "A" or "B" unless subsequent changes are made by Contractor or a contract modification. For shop drawings stamped "C" or "E," Contractor shall make corrections required, note any changes by dating the revisions to correspond with the change request date, and promptly resubmit the corrected material. Resubmittals shall be associated with the "parent" by use of sequential alpha characters (for example, resubmittal of transmittal 8 will be 8A, 8B, etc). Government costs incurred after the first resubmittal may be charged to the Contractor.

3.12 INFORMATION ONLY SUBMITTALS (FIO)

The Contractor shall submit three copies of data and four copies of ENG Form 4025. FIO submittals will not be returned. Government approval is not required on FIO submittals. These submittals will be used for information purposes. The Government reserves the right to require the Contractor to resubmit any item found not to comply with the Contract. This does not relieve the Contractor from the obligation to furnish material conforming to the plans and specifications and will not prevent the COR from requiring removal and replacement if nonconforming material is incorporated in the work. This does not relieve the Contractor of the requirement to furnish samples for testing by the Government laboratory or check testing by the Government in those instances where the technical specifications so prescribe.

3.12.1 Processing of FIO Submittals

FIO submittals shall be submitted prior to delivery of the material or equipment to the job site. ENG Form 4025 shall be marked with the words "contractor approved - information copy only" in the REMARKS block of the form. Submittals will be monitored and spot checks made. When such checks indicate noncompliance, the Contractor will be notified by the same method used for GA submittals. Resubmittal of nonconforming FIO submittals shall be reclassified GA and shall be in five copies.

3.13 CONTRACTOR APPROVAL STAMP

The stamp used by the Contractor on the submittal data to certify that the submittal meets contract requirements shall be similar to the following:

CONTRACTOR: _____

CONTRACT NUMBER _____

TRANSMITTAL NUMBER _____

ITEM NUMBER _____

SPECIFICATION SECTION _____

PARAGRAPH NUMBER _____

_____ APPROVED AS SUBMITTED

_____ APPROVED WITH CORRECTIONS AS
NOTED

SIGNATURE: _____

TITLE: _____

DATE _____

CONTRACTORS REVIEW STAMP

MAXIMUM SIZE:

3 INCHES BY 3 INCHES

INSTRUCTIONS

1. Section I will be initiated by the Contractor in the required number of copies.
2. Each transmittal shall be numbered consecutively in the space provided for "Transmittal No.". This number, in addition to the contract number, will form a serial number for identifying each submittal. For new submittals or resubmittals mark the appropriate box; on resubmittals, insert transmittal number of last submission as well as the new submittal number.
3. The "Item No." will be the same "Item No." as indicated on ENG FORM 4288-R for each entry on this form.
4. Submittals requiring expeditious handling will be submitted on a separate form.
5. Separate transmittal form will be used for submittals under separate sections of the specifications.
6. A check shall be placed in the "Variation" column when a submittal is not in accordance with the plans and specifications--also, a written statement to that effect shall be included in the space provided for "Remarks".
7. Form is self-transmittal, letter of transmittal is not required.
8. When a sample of material or Manufacturer's Certificate of Compliance is transmitted, indicate "Sample" or "Certificate" in column c, Section I.
9. U.S. Army Corps of Engineers approving authority will assign action codes as indicated below in space provided in Section I, column i to each item submitted. In addition they will ensure enclosures are indicated and attached to the form prior to return to the contractor. The Contractor will assign action codes as indicated below in Section I, column g, to each item submitted.

THE FOLLOWING ACTION CODES ARE GIVEN TO ITEMS SUBMITTED

- | | | | |
|------|--|-------|---|
| A -- | Approved as submitted. | E -- | Disapproved (See attached). |
| B -- | Approved, except as noted on drawings. | F -- | Receipt acknowledged. |
| C -- | Approved, except as noted on drawings.
Refer to attached sheet resubmission required. | FX -- | Receipt acknowledged, does not comply
as noted with contract requirements. |
| D -- | Will be returned by separate correspondence. | G -- | Other (Specify) |
10. Approval of items does not relieve the contractor from complying with all the requirements of the contract plans and specifications.

(Reverse of ENG Form 4025-R)

<p>SUBMITTAL REGISTER (ER 415-1-10)</p>	<p>CONTRACT NUMBER</p>
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SECTION 01410

ENVIRONMENTAL PROTECTION

PART 1 GENERAL REQUIREMENTS

1.1 The contractor shall perform the work minimizing environmental pollution and damage as the result of construction operations under this contract. For the purpose of this specification, environmental pollution and damage is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade the utility of the environment for aesthetic, cultural, and/or historical purposes. The control of environmental pollution and damage requires consideration of air, water, and land, and includes management of visual esthetics, noise, solid waste, and erosion from stormwater, as well as pollutants.

1.2 Abbreviations and Acronyms:

BACT	Best Available Control Technology
BMP	Best Management Practice
CFR	Code of Federal Regulations
CO	Contracting Officer
COR	Contracting Officer's Representative
DOT	Department of Transportation
ECMD	Engineering & Contract Management Division
ECO	Environmental Compliance Officer
ENRD	Environmental and Natural Resources Division
EPA	Environmental Protection Agency
HM	Hazardous Material
HMTA	Hazardous Materials Transportation Act
HW	Hazardous Waste
HWT	Hazardous Waste Technician
HWMS	Hazardous Waste Management Section
ISCP	Installation Spill Contingency Plan

MSDS	Material Safety Data Sheets
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NOI	Notice of Intent
OSHA	Occupational Safety and Health Act
PCB	Polychlorinated Biphenyls
PCS	Petroleum Contaminated Soil
PPE	Personnel Protective Equipment
PW	Public Works
PSCA	Puget Sound Clean Air Agency
RUL	Restricted Use List
SPCCP	Spill Prevention, Control and Countermeasures Plan
TPCHD	Tacoma Pierce County Health Department
WAC	Washington Administrative Code
WHPA	Well Head Protection Area
WISHA	Washington Industrial Safety and Health Act
YTC	Yakima Training Center

1.3 Protection of Environmental Resources

The environmental resources within the project boundaries and those affected outside the limits of work under this contract shall be protected during the entire period of this contract. The Contractor shall confine his activities to areas defined by the drawings and specifications.

1.4 Subcontractors

The contractor shall ensure compliance with this section by all subcontractors.

1.5 Laws and Regulations

The Contractor shall comply with all applicable Federal, State, and Local environmental, natural and cultural resources, and historic preservation laws and regulations. Specific attention is

directed to Fort Lewis Regulation No. 200-1 "Environmental Protection and Enhancement". These specifications supplement these laws and regulations.

1.6 Coordination

The Environmental and Natural Resources Division (ENRD) of PW coordinates most environmental concerns at Fort Lewis and its sub-installations. The Contractor shall make contact with them through PW, Engineering & Contract Management Division.

1.7 Submittals

Government approval is required for all submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES.

The following is a summary of required submittals. Complete details and schedules are described in the rest of the section.

Environmental Protection Plan, GA

The Contractor shall submit an environmental protection plan within 15 days after receipt of the notice to proceed. Approval of the Contractor's plan will not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures. The environmental protection plan shall include, but not be limited to, the following:

- a. A list of Federal, State, and local laws, regulations, and permits concerning environmental protection, pollution control and abatement that are applicable to the Contractor's proposed operations and the requirements imposed by those laws, regulations, and permits.
- b. Methods for protection of features to be preserved within authorized work areas like trees, shrubs, vines, grasses and ground cover, landscape features, air and water quality, fish and wildlife, soil, historical, archaeological, and cultural resources.
- c. Procedures to be implemented to provide the required environmental protection, to comply with the applicable laws and regulations, and to correct pollution due to accident, natural causes, or failure to follow the procedures of the environmental protection plan.
- d. Location of the permitted solid waste disposal facility to be used.
- e. Drawings showing locations of any proposed temporary material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials.
- f. Environmental monitoring plans for the job site, including land, water, air, and noise monitoring.
- g. Plan showing the proposed activity in each portion of the work area and identifying the areas of limited use or nonuse. Plan should include measures for marking the limits of use areas.

- h. Applicable environmental training (both formal and on the job) the Contractor's personnel have received prior to the construction period.

Hazardous Materials and Hazardous Wastes, FIO

- Hazardous Materials Inventory Form (Initial and ongoing)
- Material Safety Data Sheets (MSDS)
- Hazardous Waste Profile Sheets
- Hazardous Waste Accumulation Log
- Hazardous Waste Manifest
- PCB Transformer Certification and Information

Asbestos

- Permits and any amendments, FIO
- Management Plan, GA
- Removal Summary, FIO
- Bulk Sample Results, FIO
- Air Monitoring Sample Results (Pre-abatement, area, clearance, and personnel), FIO
- Jobsite Entry Logs, FIO
- Waste Shipment Record, FIO
- Summary of Asbestos Removed and Remaining, FIO
- 90 Day Waste Storage Facility Permits (if applicable), FIO

Lead-based Paint, FIO

- Test results
- Summary of Paint Removed and Remaining

Storm Water Pollution Prevention Plan, GA

The Contractor shall submit a Storm Water Pollution Prevention Plan (SWP3) 10 days prior to beginning work. The SWP3 plan must meet the requirements of the NPDES General Permit for Storm Water Discharges from Construction Activities. The plan must be prepared in accordance with good engineering practices and must include the four areas required by the General Permit: Site Description, Controls, Maintenance and Inspections. The detailed requirement list is included in the General Permit.

An information packet will be provided at the pre-construction conference to assist the contractor in meeting all requirements. Approval of the Contractor's plan will not relieve the Contractor of responsibility for adequate management of storm water.

The SWP3 is a dynamic document. The contractor must amend the storm water pollution prevention plan whenever there is a change in design, construction, operation or maintenance which has a significant effect on the discharge of pollutants to the waters of the United States.

Notice of Intent, GA

The Notice of Intent document must be submitted 10 days prior to beginning work to allow time for review of the document. The Contractors Notice of Intent document will be submitted with the Fort Lewis NOI as a co-permittee application. The entire NOI packet must be postmarked two days before you begin work on site.

Notice of Termination, GA

The contractor must submit a Notice of Termination to the PW Storm Water Program when the site no longer has any storm water discharges associated with the construction activity.

Inspection Documents, FIO

The contractor must submit a copy of the storm water inspection documents to PW Storm Water Program as the job progresses. Inspections are required every 14 days or within 24 hours of a 0.5" storm event. The documents will be retained on Fort Lewis for a period of 3 years.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 WORK AREA LIMITS

The Contractor shall confine all activities to areas defined by the design drawings and specifications. Prior to any construction, the Contractor shall mark the areas that will not be disturbed under this contract. Isolated areas within the general work area, which are to be saved and protected, shall also be marked or fenced. Monuments and markers shall be protected before construction operations commence. Where construction operations are to be conducted during darkness, the markers shall be visible. The Contractor's personnel shall be knowledgeable of the purpose for marking and/or protecting particular objects.

3.1.1 Contractor Facilities and Work Areas

The Contractor's field offices, staging areas, stockpile storage, and temporary buildings shall be placed in areas designated on the drawings or as directed by the Contracting Officer or their representative. Temporary movement or relocation of Contractor facilities shall be made only when approved by the Contracting Officer or their representative.

3.2 MANAGEMENT OF HAZARDOUS MATERIALS AND HAZARDOUS WASTE

3.2.1 GENERAL

3.2.1.1 Definitions

- a. Hazardous material (HM): A useful product that requires special management because it has hazardous characteristics (ignitability, corrosivity, reactivity, or toxicity) that could pose dangers to human health or the environment. A HM becomes a Hazardous Waste when it can no longer be used for its intended purpose.

b. Hazardous waste (HW): A discarded material with properties that could pose dangers to human health or the environment. A HW either exhibits a hazardous characteristic (ignitability, corrosivity, reactivity, or toxicity) or is specifically listed as a HW by the EPA or by the State.

c. Material Safety Data Sheet (MSDS): A document containing information that manufacturers are required by law to provide on all products they manufacture and sell. The MSDS is useful in evaluating the product to determine if it has hazardous constituents and the type of medical treatment in case of an accident.

3.2.1.2 Hazardous Waste Management Section (HWMS)

The Contractor shall contact the HWMS at (253) 967-4786 with any questions pertaining to the storage, use, and disposal of Hazardous Materials and/or Hazardous Waste during the execution of this contract.

3.2.1.3 Restricted Use Materials

Certain chemicals are restricted from use on Fort Lewis. These chemicals are listed on the Restricted Use List (RUL). The RUL is maintained by the PW Environmental and Natural Resources Division (ENRD) and is updated semi-annually. A print out and/or an electronic copy of the entire RUL is available from ENRD, Building 1210. The Contractor shall receive authorization from the Contracting Officer or their representative prior to using any product that contains chemicals listed on the RUL. Only materials necessary for and associated with the execution of this Contract will be allowed on Government property.

3.2.1.4 Contingency Planning and Spill Response

The Contractor shall comply with the provisions of the Fort Lewis Spill Prevention, Control and Countermeasures Plan (SPCCP) and the Installation Spill Contingency Plan (ISCP). The PW ENRD maintains these plans. The Contractor shall also maintain on site a written contingency plan for HW accumulation and HM storage areas if the work associated with this contract generates HW or require storage of HM.

3.2.1.5 Transportation of HM and HW

The Contractor shall comply with all Department of Transportation (DOT) requirements associated with HM/HW, including proper container marking/labeling and vehicle placarding when transporting HM/HW on or off the installation. The Contractor shall obtain Government approval prior to removal of any HW from the installation. Removal shall only be done by an authorized HW transporter having an EPA Identification Number and with the HW recorded on a Uniform Hazardous Waste Manifest (EPA Form 8700-22).

3.2.1.6 HM/HW Personnel and Training Requirements

The Contractor shall appoint an Environmental Compliance Officer (ECO) and a Hazardous Waste Technician (HWT) in writing, if the work associated with this contract causes the Contractor to generate, store, or handle HM/HW. The ECO/HWT shall be responsible for insuring the requirements of this specification are met.

The Contractor shall ensure that all personnel are trained in accordance with Washington Department of Ecology regulations before being assigned to any position handling HW/HM. This training shall include, but not be limited to:

- a. Hazardous Materials Use, Storage and Disposal Training Course for ECOs/HWTs. The 8 hour course is available weekly from the Fort Lewis ENRD Hazardous Waste Management Section (HWMS) and shall be taken prior to the Contractor generating, storing, or handling HM or HW on the installation. The Contractor shall contact the HWMS to schedule attendance.
- b. First Responder Awareness Level as specified in the ISCP.
- c. Quarterly contingency plan review and rehearsal.
- d. Hazard Communication training as stated in paragraph 3.2.2.5.

The Contractor shall maintain a record of all required training, and the date conducted, for each individual requiring training and shall make this record available to the Government at all times during the execution of this contract.

3.2.2 HAZARDOUS MATERIALS

3.2.2.1 Notification

The Contractor shall provide an initial inventory and MSDS copies for all HM to be used during the execution of this contract, to the PW, Engineering & Contract Management Division. The inventory shall include the type of HM, proposed storage location and quantity to be stored and shall be provided before bringing any HM onto the installation. The Contractor shall use the Hazardous Material Inventory form (HFL Form 953-Enclosure No. 1) or a contractor-generated form providing the same information. An electronic version of the Hazardous Material Inventory form is available from the PW ENRD in Building 1210.

3.2.2.2 Storage Facilities

Facilities shall meet all fire code requirements and provide adequate ventilation, containment, and protection from the elements. Provide warning signs, limit access to the facility, and lock it when it is unattended. Only HM shall be stored in the facility. Contractor vehicles are not considered a proper storage facility. No HM shall be stored in vehicles overnight or for any length of time.

3.2.2.3 Storage and Use

The Contractor shall store HM according to product labels and MSDS requirements. Non-compatible materials shall not be stored together. All containers shall be properly labeled as to contents and kept in good condition with tight fitting lids. Unopened containers shall be segregated from opened containers. Personal protective equipment (PPE) required by the MSDS or product label shall be available and worn by all personnel who handle the product.

3.2.2.4 Inspections, Record Keeping and Reporting

The Contractor shall perform weekly inspections of their HM storage facilities utilizing the HM Inspection Checklist (HFL Form 951-Enclosure No. 2). A current inventory of the HM storage facility shall be maintained on site and a copy forwarded to PW, Engineering & Contract Management Division quarterly using the Hazardous Material Inventory form. Additionally, a current MSDS for each product used or stored shall be present and on file at the site where the product is used or stored.

3.2.2.5 Hazard Communication Program

The Contractor shall have a written Hazard Communication program, which explains how personnel are informed and trained concerning HM in the workplace as required by Federal, state and Fort Lewis regulations. The written program shall be located at a hazard communication station that is accessible to all Contractor personnel and shall contain the following sections:

- a. A current inventory of HM, who is responsible for classifying a product as a HM, and how the inventory is updated.
- b. Labels and other forms of warning: This section shall describe the procedure for insuring that each HM container is clearly labeled and has the appropriate warnings. The section also states who is responsible for labeling requirements and how label information is updated.
- c. MSDS file: The location of the MSDS file, who maintains the file, and how personnel may access the file, shall be described. This section shall also describe what is done when a product is received without the MSDS and how the MSDS file is updated.
- d. Personnel training and information: This section shall describe initial and refresher training provided to personnel concerning the hazards of the HM in the workplace, the training provided, and who conducts the training.
- e. Information to non-Contractor personnel: This section shall describe how non-Contractor personnel are informed about possible hazards, where MSDS copies can be obtained, and what PPE is required in the workplace.

3.3 DISPOSAL OF SOLID WASTE.

3.3.1 General

The Contractor shall be responsible for the disposal off site of all refuse generated in the course of performance of this contract, to include containers, transport, handling, and dumping fees. All solid wastes shall be placed in containers that are emptied on a regular schedule. The Contractor will not be permitted to deposit refuse in existing garbage cans or refuse dumpsters. No burning of refuse is allowed. All vehicle loads of waste being transported shall be adequately secured to prevent spillage.

3.3.2 Clean Fill Materials

Clean fill materials shall be disposed of on Fort Lewis at a site as directed by PW, Engineering & Contract Management Division. Clean fill shall not contain any items such as vegetative material, asphalt, concrete or metals.

3.4 PROTECTION OF LAND RESOURCES

Prior to the beginning of any construction, the Contractor shall identify the land resources to be preserved within the work area. Except in areas indicated on the drawings or specified to be cleared, the Contractor shall not remove, cut, deface, injure, or destroy land resources including trees, shrubs, vines, grasses, topsoil, and land forms without special permission from the Contracting Officer or their representative. No ropes, cables, or guys shall be fastened to or attached to any trees for anchorage unless specifically authorized.

3.4.1 Landscape

Trees, shrubs, vines, grasses, land forms and other landscape features indicated and defined on the drawings to be preserved shall be clearly identified by marking, fencing, or wrapping with boards, or any other approved techniques.

3.4.2 Unprotected Erodible Soils

Earthwork brought to final grade shall be finished as indicated on the design drawings and specifications. Side slopes and back slopes shall be protected as soon as practicable upon completion of rough grading. All earthwork shall be planned and conducted to minimize the duration of exposure of unprotected soils. Except in cases where the constructed feature obscures borrow areas, quarries, and waste material areas, these areas shall not initially be totally cleared. Clearing of such areas shall progress in reasonably sized increments as needed to use the developed areas as approved by the Contracting Officer or their representative.

3.4.3 Disturbed Areas

The Contractor shall effectively prevent erosion and control sedimentation through approved methods including, but not limited to, the following:

- a. Retardation and control of runoff. Runoff from the construction site or from storms shall be controlled, retarded, and diverted to protected drainage courses by means of diversion ditches, benches, berms, and by any measures required by area wide plans under the Clean Water Act.
- b. Erosion and sedimentation control devices. The Contractor shall construct or install temporary and permanent erosion and sedimentation control features as indicated on the drawings. Berms, dikes, drains, sedimentation basins, grassing, and mulching shall be maintained until permanent drainage and erosion control facilities are completed and operative.
- c. Sediment basins. Sediment from construction areas shall be trapped in temporary or permanent sediment basins in accordance with the drawings.

The basins shall accommodate the runoff of a local 5 year, 24 hour storm. After each storm, the basins shall be pumped dry and accumulated sediment shall be removed to maintain basin effectiveness. Overflow shall be controlled by paved weirs or by vertical overflow pipes. The collected topsoil sediment shall be reused for fill on the construction site, and/or stockpiled for use at another site. The Contractor shall institute effluent quality monitoring programs as required by State and local environmental agencies.

3.4.4 Tree Protection

The Contractor shall exercise care when excavating trenches in the vicinity of trees. Where roots are two inches in diameter or greater, the trench shall be excavated by hand or tunneled. When large roots are exposed, they shall be wrapped with heavy burlap for protection and to prevent drying. Trenches dug by machines adjacent to trees having roots less than two inches in diameter shall have the sides hand trimmed, making a clean cut of the roots. Trenches having exposed tree roots shall be backfilled within 24 hours unless adequately protected by moist burlap or canvas.

3.4.5 Trees Removed During Construction

Logs from trees removed during construction shall be decked for subsequent disposal by the Government. Decks shall be located so as not to interfere with the construction work and shall be located as directed by PW, Engineering & Contract Management Division. Logs shall be sorted by size and placed in separate decks for sawlogs and fuelwood. Trees shall be cut from the stump and limbed to the top before decking. Whenever possible logs shall be left in tree length. If trees are too large to be handled tree length, cut 40-foot logs plus 12 inches trim allowance from the butt. The minimum size for a sawlog is 6 diameter inches on the small end and 16 foot in length. All logs not suitable for sawlogs shall be placed in a fuelwood deck. The minimum size for a fuelwood log is 5 inches diameter on the large end and 8 feet in length.

3.4.6 Restoration of Landscape Damage

All landscape features (vegetation - such as trees, plants, and grass) damaged or destroyed during Contractor operations outside and within the work areas shall be restored by the Contractor to a condition similar to that which existed prior to construction activities unless otherwise indicated on the drawings or in the specifications. All vegetation that was removed or damaged consisting of native species shall be replaced with native species. If the area had been previously landscaped with non-native species then similar plants shall be used for replacement. Landscaping shall be maintained for a minimum of 60 days after planting, to include irrigation. The Contractor shall coordinate with ENRD prior to planting any non-native species.

Trees shall be replaced in kind with a minimum 4-inch caliper nursery stock. Shrubs, vines, and ground cover shall be replaced in kind; the Contracting Officer or their representative shall approve size. All plant material shall meet specifications outlined in ANSI Z60.1 - current publication, "American Standard for Nursery Stock."

Grass areas shall be replaced in kind by sodding or seeding. Sod shall be required in all regularly maintained lawn areas.

Plant material damaged or destroyed within the historical district shall be replaced or repaired as directed by the Contracting Officer or their representative.

3.5 PROTECTION OF WATER RESOURCES

3.5.1 General

The Contractor shall keep construction activities under surveillance, management, and control to avoid pollution of surface and ground waters. Toxic or hazardous chemicals shall not be applied to soil or vegetation when such application may cause contamination of the fresh water reserve. Monitoring of water areas affected by construction shall be the Contractor's responsibility. The Contractor shall monitor all water areas affected by construction activities. The Contractor shall observe all prescribed setbacks from streams and wetlands as specified in FL REG 200-1.

3.5.2 Washing and Curing Water

Stormwaters from sites less than 5 acres, directly derived from construction activities shall not be allowed to enter water areas. Stormwaters shall be collected and placed in retention ponds where suspended material can be settled out or the water evaporates to separate pollutants from the water. Analysis shall be performed and results reviewed and approved before water in retention ponds is discharged.

3.5.3 Fish and Wildlife

The Contractor shall minimize interference with, disturbance to, and damage of fish and wildlife. The Contractor prior to beginning of construction operations shall list species that require specific attention along with measures for their protection.

3.5.4 Wellhead Protection Areas

Particular care shall be taken to prevent the introduction of any contaminant to the surface in a designated Wellhead Protection Area (WPA). Certain activities that may pose a danger to groundwater resources are prohibited within WPAs.

3.5.5 Storm Water Management

3.5.5.1 Standard Permit Conditions

The Contractor must comply with all conditions of the NPDES General Permit for Storm Water Discharges from Construction Activities. NPDES Permits are required for all construction jobs of 5 acres or greater.

Once the Contractor's SWP3 and NOI are approved by PW ENRD (see 1.7 SUBMITTALS), the NOI will be submitted to the Environmental Protection Agency (EPA) with the Fort Lewis NOI as a co-applicant request to be covered under the NPDES General Permit. This packet must be mailed two days prior to work beginning on the project. The packet will be submitted by the PW ENRD Storm Water Program.

When a permit number is issued by EPA, the document will be forwarded to the project site and kept on file for the duration of the project.

3.5.5.2 Inspections and Documentation

Qualified personnel (provided by the Contractor) shall inspect disturbed areas of the construction site at least once every fourteen (14) calendar days and within 24 hours of the end of a storm event of 0.5 inches precipitation or greater. Areas inspected must include those that have not been finally stabilized, areas used for storage of materials that are exposed to precipitation, structural control measures, and locations where vehicles enter or exit the site. The inspection documents must be retained as part of the SWP3 plan on site and a copy will also be forwarded to PW ENRD Storm Water Program.

A minimum of one inspection will be conducted by the Fort Lewis Storm Water Specialist to assess site compliance with the Storm Water Pollution Prevention Plan during the life of the project.

3.5.5.3 Maintenance

When required site inspections identify best management practices that are not operating effectively, maintenance shall be performed before the next anticipated storm event, or as necessary to maintain the continued effectiveness of storm water controls.

3.5.5.4 Post-Construction

For construction activities, elimination of all storm water discharges associated with the activity occurs when disturbed soils at the construction site have been finally stabilized and temporary erosion and sediment control measures have been removed, or will be removed at an appropriate time. Final stabilization means that all soil disturbing activities at the site have been completed and a uniform perennial vegetative cover with a density of 70% of the cover for unpaved areas and areas not covered by permanent structures has been established or equivalent permanent stabilization measures have been employed.

All items requiring submittal to the PW-ENRD Storm Water Program may be delivered to the following address:

Public Works
ENRD-Storm Water
Bldg. 2012, Room 323
PO Box 339500
Fort Lewis, WA

(253) 966-1795

3.6 PROTECTION OF AIR RESOURCES

3.6.2 General

Dust particles, aerosols, and gaseous byproducts from construction activities, processing, and preparation of materials shall be controlled at all times, including weekends, holidays, and hours when work is not in progress. Hydrocarbons and carbon monoxide emissions from equipment shall be controlled to Federal and state allowable limits at all times. The Contractor

shall not conceal or mask the emission of an air pollutant which violates air pollution regulations or causes a detriment to the health, safety, or welfare of any person.

An air pollution source shall not emit air pollutants in such quantities and of such characteristics and duration which are likely to be injurious to human health, plant or animal life, property, or which unreasonably interfere with enjoyment of life and property.

3.6.2 Fugitive Dust

Fugitive dust created as a result of construction activities shall be controlled with the BACT such as spraying with water. Contractor vehicles shall not enter public roadways with deposits of mud, dirt, or other debris or unsecured loads. Fugitive dust shall not be emitted from air pollution generating equipment such as boilers and incinerators.

3.6.3 Painting Operations

Spray painting shall not be conducted except inside a paint booth, which utilizes a dry filter system and is approved by ENRD for use. This requirement does not apply to the use of hand-held aerosol cans, coating of buildings and similar type structures, and painting of other items which ENRD deems can not be sprayed in a paint booth.

3.6.4 Burning Natural Vegetation

All cantonment areas, housing areas and all of North Fort are designated as no burn areas. A burning permit is required for burning natural vegetation in all other areas on Fort Lewis. Burning permits may be obtained from the PW Forestry Section. A copy of the permit shall be submitted to PW, Engineering & Contract Management Division.

3.6.5 Best Available Control Technology (BACT)

The Contractor shall utilize the BACT as determined by the regulatory authority on all air pollution sources. The Contracting Officer or their representative shall be notified for resolution if this requires a change in the design.

3.7 PROTECTION OF FISH AND WILDLIFE

The Contractor shall conduct their operations in a manner that will minimize impacts on surrounding fish and wildlife. If, during construction activities, the Contractor observes any Federal or State protected species, the Contractor shall immediately contact the Contracting Officer or their representative and cease all activities at the site.

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SECTION 01415

METRIC MEASUREMENTS

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 380 (1993) Practice for Use of the International System of Units (SI)

ASTM E 621 (1999 e1) Practice for Use of Metric (SI) Units in Building Design and Construction

1.2 GENERAL

This project includes metric units of measurements. The metric units used are the International System of Units (SI) developed and maintained by the General Conference on Weights and Measures (CGPM); the name International System of Units and the international abbreviation SI were adopted by the 11th CGPM in 1960. A number of circumstances require that both metric SI units and English inch-pound (I-P) units be included in a section of the specifications. When both metric and I-P measurements are included, the section may contain measurements for products that are manufactured to I-P dimensions and then expressed in mathematically converted metric value (soft metric) or, it may contain measurements for products that are manufactured to an industry recognized rounded metric (hard metric) dimensions but are allowed to be substituted by I-P products to comply with the law. Dual measurements are also included to indicate industry and/or Government standards, test values or other controlling factors, such as the code requirements where I-P values are needed for clarity or to trace back to the referenced standards, test values or codes. For American Society for Testing and Materials (ASTM) references in the technical specifications, the Contractor shall use the metric publication, if one is available (For example: ASTM A 36, use ASTM A 36M). An acceptable substitute to hard Metric SI Concrete Masonry Units (CMU) and Recessed Lighting Fixtures (RLF) is English in-pound (soft metric) CMU and RLF. The Contractor shall be responsible for any adjustments required to accommodate these alternative English in-pound units at no additional cost to the Government.

1.3 USE OF MEASUREMENTS

Measurements shall be either in SI or I-P units as indicated, except for soft metric measurements or as otherwise authorized. The Contractor shall be responsible for all associated labor and materials when authorized to substitute one system of units for another and for the final assembly and performance of the specified work and/or products.

1.3.1 Hard Metric

A hard metric measurement is indicated by an SI value with no expressed correlation to an I-P value, i.e., where an SI value is not an exact mathematical conversion of an I-P value, such as the use of 100 mm in lieu of 4 inches. Hard metric products are required when only metric

dimensions are indicated, except for Contractor's options as outlined in paragraph GENERAL above. Hard metric measurements are often used for field data such as distance from one point to another or distance above the floor. Products are considered to be hard metric when they are manufactured to metric dimensions or have an industry recognized metric designation.

1.3.2 Soft Metric

a. A soft metric measurement is indicated by an SI value which is a mathematical conversion of the I-P value shown in parentheses e.g. 38.1 mm (1-1/2 inches). Soft metric measurements are used for measurements pertaining to products, test values, and other situations where the I-P units are the standard for manufacture, verification, or other controlling factor. The I-P value shall govern while the metric measurement is provided for information.

b. A soft metric measurement is also indicated for products that are manufactured in industry designated metric dimensions but are required by law to allow substitute I-P products. These measurements are indicated by a manufacturing hard metric product dimension followed by the substitute I-P equivalent value in parentheses e.g., 190 x 190 x 390 mm (7-5/8 x 7-5/8 x 15-5/8 inches).

1.3.3 Neutral

A neutral measurement is indicated by an identifier which has no expressed relation to either an SI or an I-P value (e.g., American Wire Gage (AWG) which indicates thickness but in itself is neither SI nor I-P).

1.4 COORDINATION

Discrepancies, such as mismatches or product unavailability, arising from use of both metric and non-metric measurements and discrepancies between the measurements in the specifications and the measurements in the drawings shall be brought to the attention of the Contracting Officer for resolution.

1.5 RELATIONSHIP TO SUBMITTALS

Submittals for Government approval or for information only shall cover the SI or I-P products actually being furnished for the project. The Contractor shall submit the required drawings and calculations in the same units used in the contract documents describing the product or requirement unless otherwise instructed or approved. The Contractor shall use ASTM E 380 and ASTM E 621 as the basis for establishing metric measurements required to be used in submittals.

END OF SECTION

SECTION 01451

CONTRACTOR QUALITY CONTROL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3740	(2001) Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction
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ASTM E 329	(2000b) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction
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1.2 PAYMENT

Separate payment will not be made for providing and maintaining an effective Quality Control program, and all costs associated therewith shall be included in the applicable unit prices or lump-sum prices contained in the Bidding Schedule.

1.3 LABORATORY VALIDATION

The testing laboratory shall be validated by Corps of Engineers Material Testing Center (MTC) for all tests required by contract. See paragraph 3.7 TESTS.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

The Contractor is responsible for quality control and shall establish and maintain an effective quality control system in compliance with the Contract Clause titled "Inspection of Construction." The quality control system shall consist of plans, procedures, and organization necessary to produce an end product which complies with the contract requirements. The system shall cover all construction operations, both onsite and offsite, and shall be keyed to the proposed construction sequence. The site project superintendent will be held responsible for the quality of work on the job and is subject to removal by the Contracting Officer for non-compliance with quality requirements specified in the contract. The site project superintendent in this context shall be the highest level manager responsible for overall construction activities at the site, including quality and production. The site project superintendent shall maintain a physical presence at the site at all times, except as otherwise

acceptable to the Contracting Officer, and shall be responsible for all construction and construction related activities at the site.

3.2 QUALITY CONTROL PLAN

3.2.1 General

The Contractor shall furnish for review by the Government, not later than 10 days after receipt of notice to proceed, the Contractor Quality Control (CQC) Plan proposed to implement the requirements of the Contract Clause titled "Inspection of Construction." The plan shall identify personnel, procedures, control, instructions, test, records, and forms to be used. The Government will consider an interim plan for the first 60 days of operation. Construction will be permitted to begin only after acceptance of the CQC Plan or acceptance of an interim plan applicable to the particular feature of work to be started. Work outside of the features of work included in an accepted interim plan will not be permitted to begin until acceptance of a CQC Plan or another interim plan containing the additional features of work to be started.

3.2.2 Content of the CQC Plan

The CQC Plan shall include, as a minimum, the following to cover all construction operations, both onsite and offsite, including work by subcontractors, fabricators, suppliers, and purchasing agents:

- a. A description of the quality control organization, including a chart showing lines of authority and acknowledgment that the CQC staff shall implement the three phase control system for all aspects of the work specified. The staff shall include a CQC System Manager who shall report to the project manager. If the project manager and project superintendent is the same person, the CQC System Manager shall report to someone higher in the Contractor's organization than the project manager.
- b. The name, qualifications (in resume format), duties, responsibilities, and authorities of each person assigned a CQC function.
- c. A copy of the letter to the CQC System Manager signed by an authorized official of the firm which describes the responsibilities and delegates sufficient authorities to adequately perform the functions of the CQC System Manager, including authority to stop work which is not in compliance with the contract. The CQC System Manager shall issue letters of direction to all other various quality control representatives outlining duties, authorities, and responsibilities. Copies of these letters shall also be furnished to the Government.
- d. Procedures for scheduling, reviewing, certifying, and managing submittals, including those of subcontractors, offsite fabricators, suppliers, and purchasing agents. These procedures shall be in accordance with Section 01330 SUBMITTAL PROCEDURES.
- e. Control, verification, and acceptance testing procedures for each specific test to include the test name, specification paragraph requiring test, feature of work to be

tested, test frequency, and person responsible for each test. Laboratory facilities will be validated by the Corps of Engineers Material Testing Center and approved by the Contracting Officer.

- f. Procedures for tracking preparatory, initial, and follow-up control phases and control, verification, and acceptance tests including documentation.
- g. Procedures for tracking construction deficiencies from identification through acceptable corrective action. These procedures shall establish verification that identified deficiencies have been corrected.
- h. Reporting procedures, including proposed reporting formats.
- i. A list of the definable features of work. A definable feature of work is a task which is separate and distinct from other tasks, has separate control requirements, and may be identified by different trades or disciplines, or it may be work by the same trade in a different environment. Although each section of the specifications may generally be considered as a definable feature of work, there are frequently more than one definable features under a particular section. This list will be agreed upon during the coordination meeting.

3.2.3 Acceptance of Plan

Acceptance of the Contractor's plan is required prior to the start of construction. Acceptance is conditional and will be predicated on satisfactory performance during the construction. The Government reserves the right to require the Contractor to make changes in his CQC Plan and operations including removal of personnel, as necessary, to obtain the quality specified.

3.2.4 Notification of Changes

After acceptance of the CQC Plan, the Contractor shall notify the Contracting Officer in writing of any proposed change. Proposed changes are subject to acceptance by the Contracting Officer.

3.3 COORDINATION MEETING

After the Preconstruction Conference, before start of construction, and prior to acceptance by the Government of the CQC Plan, the Contractor shall meet with the Contracting Officer or Authorized Representative and discuss the Contractor's quality control system. The CQC Plan shall be submitted for review a minimum of 5 calendar days prior to the Coordination Meeting. During the meeting, a mutual understanding of the system details shall be developed, including the forms for recording the CQC operations, control activities, testing, administration of the system for both onsite and offsite work, and the interrelationship of Contractor's Management and control with the Government's Quality Assurance. Minutes of the meeting shall be prepared by the Government and signed by both the Contractor and the Contracting Officer. The minutes shall become a part of the contract file. There may be occasions when subsequent conferences will be called by either party to reconfirm mutual understandings and/or address deficiencies in the CQC system or procedures which may require corrective action by the Contractor.

3.4 QUALITY CONTROL ORGANIZATION

3.4.1 Personnel Requirements

The requirements for the CQC organization are a CQC System Manager and sufficient number of additional qualified personnel to ensure safety and contract compliance. The Safety and Health manager shall receive direction and authority from the CQC System manager and shall serve as a member of the CQC staff. Personnel identified in technical provisions as requiring specialized skills to assure the required work is being performed properly will also be included as part of the CQC organization. The Contractor shall provide a CQC organization which shall be at the site at all times during progress of the work and with complete authority to take any action necessary to ensure compliance with the contract. All CQC staff members shall be subject to acceptance by the Contracting Officer. The Contractor shall provide adequate office space, filing systems and other resources as necessary to maintain an effective and fully functional CQC organization. Complete records of all letters, material submittals, shop drawings submittals, schedules and all other project documentation shall be promptly furnished to the CQC organization by the Contractor. The CQC organization shall be responsible to maintain these documents and records at the site at all times, except as otherwise acceptable to the Contracting Officer.

3.4.2 CQC System Manager

The Contractor shall identify as CQC System Manager an individual within the onsite work organization who shall be responsible for overall management of CQC and have the authority to act in all CQC matters for the Contractor. The CQC System Manager shall be a graduate engineer, graduate architect, or a graduate of construction management, with a minimum of 5 years construction experience on construction similar to this contract or a construction person with a minimum of 10 years in related work. This CQC System Manager shall be on the site at all times during construction and shall be employed by the prime Contractor. The CQC System Manager shall be assigned no other duties. An alternate for the CQC System Manager shall be identified in the plan to serve in the event of the System Manager's absence. The requirements for the alternate shall be the same as for the designated CQC System Manager.

3.4.3 CQC Personnel

In addition to CQC personnel specified elsewhere in the contract, the Contractor shall provide as part of the CQC organization specialized personnel to assist the CQC System Manager for the following areas: mechanical. These individuals may be employees of the prime or subcontractor; be responsible to the CQC System Manager; be physically present at the construction site during work on their areas of responsibility; have the necessary education and/or experience in accordance with the experience matrix listed herein. These individuals shall have no other duties other than quality control.

Experience Matrix		
	<u>Area</u>	<u>Qualifications</u>
	Mechanical	Graduate Mechanical Engineer with 2 years experience or person with 5 years related experience

3.4.4 Additional Requirement

In addition to the above experience and/or education requirements the CQC System Manager shall have completed the course entitled "Construction Quality Management For Contractors". This course is periodically offered at AGC offices throughout the state of Washington and Oregon.

3.4.5 Organizational Changes

The Contractor shall maintain the CQC staff at full strength at all times. When it is necessary to make changes to the CQC staff, the Contractor shall revise the CQC Plan to reflect the changes and submit the changes to the Contracting Officer for acceptance.

3.5 SUBMITTALS AND DELIVERABLES

Submittals, if needed, shall be made as specified in Section 01330 SUBMITTAL PROCEDURES. The CQC organization shall be responsible for certifying that all submittals are in compliance with the contract requirements. When Section 15950A HEATING, VENTILATING AND AIR CONDITIONING (HVAC) CONTROL SYSTEMS, 15951A DIRECT DIGITAL CONTROL FOR HVAC; 15990A TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS; or 15995A COMMISSIONING OF HVAC SYSTEMS are included in the contract, the submittals required by these sections shall be coordinated with Section 01330 SUBMITTAL PROCEDURES to ensure adequate time is allowed for each type of submittal required. All Contractor forms for submitting test results are subject to Contracting Officer approval.

3.6 CONTROL

Contractor Quality Control is the means by which the Contractor ensures that the construction, to include that of subcontractors and suppliers, complies with the requirements of the contract. At least three phases of control shall be conducted by the CQC System Manager for each definable feature of work as follows:

3.6.1 Preparatory Phase

This phase shall be performed prior to beginning work on each definable feature of work, after all required plans/documents/materials are approved/accepted, and after copies are at the work site. This phase shall include:

- a. A review of each paragraph of applicable specifications, reference codes, and standards. A copy of those sections of referenced codes and standards applicable to that portion of the work to be accomplished in the field shall be made available by the Contractor at the preparatory inspection. These copies shall be maintained

in the field and available for use by Government personnel until final acceptance of the work.

- b. A review of the contract drawings.
- c. A check to assure that all materials and/or equipment have been tested, submitted, and approved.
- d. Review of provisions that have been made to provide required control inspection and testing.
- e. Examination of the work area to assure that all required preliminary work has been completed and is in compliance with the contract.
- f. A physical examination of required materials, equipment, and sample work to assure that they are on hand, conform to approved shop drawings or submitted data, and are properly stored.
- g. A review of the appropriate activity hazard analysis to assure safety requirements are met.
- h. Discussion of procedures for controlling quality of the work including repetitive deficiencies. Document construction tolerances and workmanship standards for that feature of work.
- i. A check to ensure that the portion of the plan for the work to be performed has been accepted by the Contracting Officer.
- j. Discussion of the initial control phase.
- k. The Government shall be notified at least 48 hours in advance of beginning the preparatory control phase. This phase shall include a meeting conducted by the CQC System Manager and attended by the superintendent, other CQC personnel (as applicable), and the foreman responsible for the definable feature. The results of the preparatory phase actions shall be documented by separate minutes prepared by the CQC System Manager and attached to the daily CQC report. The Contractor shall instruct applicable workers as to the acceptable level of workmanship required in order to meet contract specifications.

3.6.2 Initial Phase

This phase shall be accomplished at the beginning of a definable feature of work. The following shall be accomplished:

- a. A check of work to ensure that it is in full compliance with contract requirements. Review minutes of the preparatory meeting.
- b. Verify adequacy of controls to ensure full contract compliance. Verify required control inspection and testing.

- c. Establish level of workmanship and verify that it meets minimum acceptable workmanship standards. Compare with required sample panels as appropriate.
- d. Resolve all differences.
- e. Check safety to include compliance with and upgrading of the safety plan and activity hazard analysis. Review the activity analysis with each worker.
- f. The Government shall be notified at least 24 hours in advance of beginning the initial phase. Separate minutes of this phase shall be prepared by the CQC System Manager and attached to the daily CQC report. Exact location of initial phase shall be indicated for future reference and comparison with follow-up phases.
- g. The initial phase should be repeated for each new crew to work onsite, or any time acceptable specified quality standards are not being met.

3.6.3 Follow-up Phase

Daily checks shall be performed to assure control activities, including control testing, are providing continued compliance with contract requirements, until completion of the particular feature of work. The checks shall be made a matter of record in the CQC documentation. Final follow-up checks shall be conducted and all deficiencies corrected prior to the start of additional features of work which may be affected by the deficient work. The Contractor shall not build upon nor conceal non-conforming work.

3.6.4 Additional Preparatory and Initial Phases

Additional preparatory and initial phases shall be conducted on the same definable features of work if the quality of on-going work is unacceptable, if there are changes in the applicable CQC staff, onsite production supervision or work crew, if work on a definable feature is resumed after a substantial period of inactivity, or if other problems develop.

3.7 TESTS

3.7.1 Testing Procedure

The Contractor shall perform specified or required tests to verify that control measures are adequate to provide a product which conforms to contract requirements, see Table 1 – Minimum Testing, attached at the end of this specification section. Contractor shall submit all materials test reports on forms standard to industry standards such as ACI, ASTM and AASHTO or with laboratory accreditation forms such as AALA, NIST or NVLAP. Upon request, the Contractor shall furnish to the Government duplicate samples of test specimens for possible testing by the Government. Testing includes operation and/or acceptance tests when specified. The Contractor shall procure the services of a Corps of Engineers validated testing laboratory or establish a testing laboratory at the project site which can be validated by the Corps of Engineers in advance of any and all required testing; and in addition, submit proof of validation for approval. The Contractor shall perform the following activities and record and provide the following data:

- a. Verify that testing procedures comply with contract requirements.
- b. Verify that facilities and testing equipment are available and comply with testing standards.
- c. Check test instrument calibration data against certified standards.
- d. Verify that recording forms and test identification control number system, including all of the test documentation requirements, have been prepared.
- e. Results of all tests taken, both passing and failing tests, shall be recorded on the CQC report for the date taken. Specification paragraph reference, location where tests were taken, and the sequential control number identifying the test shall be given. If approved by the Contracting Officer, actual test reports may be submitted later with a reference to the test number and date taken. An information copy of tests performed by an offsite or commercial test facility shall be provided directly to the Contracting Officer. Failure to submit timely test reports as stated may result in nonpayment for related work performed and disapproval of the test facility for this contract.

3.7.2 Testing Laboratories

a. Validation

The testing laboratory shall be validated by the Corps of Engineers Materials Testing Center (MTC) for all tests required by the contract prior to the performance of any such testing. The validation of a laboratory is site specific and cannot be transferred or carried over to a facility at a different location. Any and all costs associated with this Government laboratory validation shall be borne by the laboratory and/or the Contractor. Validation of a laboratory is not granted for the entire laboratory activity, but only for the specific procedures requested by the inspected laboratory. The inspected laboratory has full choice of the procedures to be inspected except that the Quality Assurance portion of ASTM E 329 is mandatory to be inspected.

(1) Validation Procedures

Validation of a laboratory may consist of either an inspection or audit as defined herein. Validation of all material testing laboratories shall be performed by the MTC. Validation may be accomplished by one of the following processes:

(a) Inspection. Inspection shall be performed by the MTC in accordance with American Society for Testing and Materials (ASTM) standards E329 and D3740.

(b) Audit. A laboratory may be validated by auditing if it has been accredited by the Concrete and Cement Reference Laboratory (CCRL) or AASHTO Materials Reference Laboratory (AMRL) within the past two years in accordance with ASTM E329. Audit shall be performed by the MTC. Inspection by MTC may be required after auditing if one or more of the critical testing procedures required in the project

specification were not included in the CCRL or AMRL inspection report or if there is any concern that the laboratory may not be able to provide required services.

b. Standards of Acceptability

(1) Aggregate, concrete, bituminous materials, soil, and rock. Laboratories for testing aggregate, concrete, bituminous materials, soil, and rock shall be validated for compliance with ASTM E 329, Engineer Manual (EM) 1110-2-1906, or project specifications, as applicable.

(2) Water, sediment, and other samples. Laboratories engaged in analysis of water, sediment, and other samples for chemical analysis shall be inspected to assure that they have the capability to perform analyses and quality control procedures described in references in Appendix A as appropriate. The use of analytical methods for procedures not addressed in these references will be evaluated by the CQAB for conformance with project or program requirements.

(3) Steel and other construction materials. Laboratories testing steel and other construction materials shall be validated for capabilities to perform tests required by project requirements and for compliance with ASTM E329.

c. Validation Schedule

(1) For all contracted laboratories and project Quality Assurance (QA) laboratories testing aggregate, concrete, bituminous materials, soils, rock, and other construction materials, an initial validation shall be performed prior to performance of testing and at least every two (2) years thereafter.

(2) Laboratories performing water quality, wastewater, sludge, and sediment testing shall be approved at an interval not to exceed eighteen (18) months.

(3) All laboratories shall be revalidated at any time at the discretion of the Corps of Engineers when conditions are judged to differ substantially from the conditions when last validated.

d. Validation Process

If a validated laboratory is unavailable or the Contractor selects to use a laboratory which has not been previously validated, Contractor shall coordinate with Corps of Engineers Material Testing Center (MTC) to obtain validation and pay all associated costs. Point of contact at MTC is Daniel Leavell, telephone (601) 634-2496, fax (601) 634-4656, email daniel.a.leavell@erdc.usace.army.mil, at the following address:

U.S. Army Corps of Engineers
Materials Testing Center
Waterways Experiment Station
3909 Hall Ferry Road
Vicksburg, MS 39180-6199

Procedure for Corps of Engineers validation, including qualifications and inspection/audit request forms are available at the MTC web site:

<http://www.wes.army.mil/SL/MTC/mtc.htm>

Contractor shall coordinate directly with the MTC to obtain validation. Contractor is cautioned the validation process is complicated and lengthy, may require an onsite inspection by MTC staff, correction of identified deficiencies, and the submittal and approval of significant documentation. Estimate a minimum of 60 days to schedule an inspection/submittal and receive a validation. Cost of onsite inspections is \$4500 plus travel time and cost from Vicksburg MS. Cost of audits is \$2500. If an onsite inspection is required following an audit, the cost of the inspection shall be \$2500 plus travel time and cost. The Contractor will be invoiced for actual travel costs and shall submit payment direct to the MTC made payable to the ERDC Finance and Accounting Officer prior to the scheduling of the inspection and/or audit. The Contractor shall copy the Contracting Officer of all correspondence and submittals to the MTC for purposes of laboratory validation.

3.7.3 Onsite Laboratory

The Government reserves the right to utilize the Contractor's control testing laboratory and equipment to make assurance tests and to check the Contractor's testing procedures, techniques, and test results at no additional cost to the Government.

3.7.4 Furnishing or Transportation of Samples for Testing

Costs incidental to the transportation of samples or materials will be borne by the Contractor. Samples of materials for test verification and acceptance testing by the Government shall be delivered to the Corps of Engineers Division Laboratory, f.o.b., at the following address:

U.S. Army Corps of Engineers
Materials Testing Center
Waterways Experiment Station
3909 Hall Ferry Road
Vicksburg, MS 39180-6199
Phone: (601) 634-2496 or (601) 634-3261

ATTN: Project _____, Contract Number _____

Coordination for each specific test, exact delivery location and dates will be made through the Area Office. If samples are scheduled to arrive at the laboratory on a weekend (after 1700 Friday through Sunday) notify the laboratory at least 24 hours in advance at (601) 634-2496 to arrange for delivery.

3.8 COMPLETION INSPECTION

3.8.1 Punch-Out Inspection

Near the completion of all work or any increment thereof established by a completion time stated in the Special Clause entitled "Commencement, Prosecution, and Completion of

Work," or stated elsewhere in the specifications, the CQC System Manager shall conduct an inspection of the work and develop a punch list of items which do not conform to the approved drawings and specifications. Such a list of deficiencies shall be included in the CQC documentation, as required by paragraph DOCUMENTATION below, and shall include the estimated date by which the deficiencies will be corrected. The CQC System Manager or staff shall make a second inspection to ascertain that all deficiencies have been corrected. Once this is accomplished, the Contractor shall notify the Government that the facility is ready for the Government Pre-Final inspection.

3.8.2 Pre-Final Inspection

The Government will perform this inspection to verify that the facility is complete and ready to be occupied. A Government Pre-Final Punch List may be developed as a result of this inspection. The Contractor's CQC System Manager shall ensure that all items on this list have been corrected before notifying the Government so that a Final inspection with the customer can be scheduled. Any items noted on the Pre-Final inspection shall be corrected in a timely manner. These inspections and any deficiency corrections required by this paragraph shall be accomplished within the time slated for completion of the entire work or any particular increment thereof if the project is divided into increments by separate completion dates.

3.8.3 Final Acceptance Inspection

The Contractor's Quality Control Inspection personnel, plus the superintendent or other primary management person, and the Contracting Officer's Representative shall be in attendance at this inspection. Additional Government personnel including, but not limited to, those from Base/Post Civil Facility Engineer user groups, and major commands may also be in attendance. The final acceptance inspection will be formally scheduled by the Contracting Officer based upon results of the Pre-Final inspection. Notice shall be given to the Contracting Officer at least 14 days prior to the final acceptance inspection and shall include the Contractor's assurance that all specific items previously identified to the Contractor as being unacceptable, along with all remaining work performed under the contract, will be complete and acceptable by the date scheduled for the final acceptance inspection. Failure of the Contractor to have all contract work acceptably complete for this inspection will be cause for the Contracting Officer to bill the Contractor for the Government's additional inspection cost in accordance with the contract clause titled "Inspection of Construction".

3.9 DOCUMENTATION

The Contractor shall maintain current records providing factual evidence that required quality control activities and/or tests have been performed. These records shall include the work of subcontractors and suppliers and shall be on an acceptable form that includes, as a minimum, the following information:

- a. Contractor/subcontractor and their area of responsibility.
- b. Operating plant/equipment with hours worked, idle, or down for repair.

- c. Work performed each day, giving location, description, and by whom. When Network Analysis (NAS) is used, identify each phase of work performed each day by NAS activity number.
- d. Test and/or control activities performed with results and references to specifications/drawings requirements. The control phase should be identified (Preparatory, Initial, Follow-up). List deficiencies noted along with corrective action.
- e. Quantity of materials received at the site with statement as to acceptability, storage, and reference to specifications/drawings requirements.
- f. Submittals reviewed, with contract reference, by whom, and action taken.
- g. Off-site surveillance activities, including actions taken.
- h. Job safety evaluations stating what was checked, results, and instructions or corrective actions.
- i. Instructions given/received and conflicts in plans and/or specifications.
- j. Contractor's verification statement.

These records shall indicate a description of trades working on the project; the number of personnel working; weather conditions encountered; and any delays encountered. These records shall cover both conforming and deficient features and shall include a statement that equipment and materials incorporated in the work and workmanship comply with the contract. The original and one copy of these records in report form shall be furnished to the Government daily within 24 hours after the date covered by the report, except that reports need not be submitted for days on which no work is performed. As a minimum, one report shall be prepared and submitted for every 7 days of no work and on the last day of a no work period. All calendar days shall be accounted for throughout the life of the contract. The first report following a day of no work shall be for that day only. Reports shall be signed and dated by the CQC System Manager. The report from the CQC System Manager shall include copies of test reports and copies of reports prepared by all subordinate quality control personnel.

3.10 SAMPLE FORMS

Sample forms are attached at the end of this specification section.

3.11 NOTIFICATION OF NONCOMPLIANCE

The Contracting Officer will notify the Contractor of any detected noncompliance with the foregoing requirements. The Contractor shall take immediate corrective action after receipt of such notice. Such notice, when delivered to the Contractor at the work site, shall be deemed sufficient for the purpose of notification. If the Contractor fails or refuses to comply promptly, the Contracting Officer may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to such stop

orders shall be made the subject of claim for extension of time or for excess costs or damages by the Contractor.

TABLE 1
MINIMUM SAMPLING AND TESTING FREQUENCY

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
<u>Fills, Embankments, Backfills, Subgrade, Subbase, and Base Course Material</u>		
Fill and Embankment	Field Density ^{<u>2/12/</u>}	Two tests per lift for each increment or fraction of 1,672 square meters (2000 sy) and any time material type changes.
	Lab Density ^{<u>3/</u>}	One test initially per each type of materials or blended material and any time material type changes, and one every 10 field density tests.
	Gradation ^{<u>1/</u>}	One test every 153 cubic meters (200 cubic yards) of fill for each type of materials or blended material and any time material type changes.
Subgrade	Field Density ^{<u>2/12/</u>}	One test per each increment or fraction of 84 square meters (100 s.y.)
	Lab Density ^{<u>3/</u>}	One test every 10 field density tests.
Backfill for Culverts, Trenches, Buildings and Walls, Pavements, and Other Structures	Field Density ^{<u>2/12/</u>}	Culverts: One test per each lift.
		Trenches: One test per lift for each increment or fraction of 152 lineal meters (500 linear feet) for backfill. Under pavements, one test every lift and at every crossing.
		Walls and Buildings Perimeters, Including Footings: One test per lift for each increment or fraction of 61 lineal meters (200 linear feet) of backfill.

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
		Buildings Slabs on Grade: One test per lift for each increment or fraction of 93 square meters (1000 s.f.)
		Areas enclosed by grade beams, compacted with power driven hand operated compactors: One test per lift for each increment or fraction of 46 square meters (500 s.f.)
		Pavements: Two tests per lift for each increment or fraction of 1,672 square meters (2000 s.y.)
		Other Structures: One test per lift for each increment or fraction of 61 lineal meters (200 linear feet) of backfill.
	Lab Density ^{3/}	One test initially per each type of material or blended material and one every 10 field density tests.
	Gradation ^{1/}	One test per each type of material or blended material and one every 10 field density tests.
Subbase and Base	Gradation ^{1/} (including .02 mm particles size limits.	1 sample for every 3,345 square meters (4,000 sy.)
	In-Place Density ^{2/} ^{12/}	1 sample every 1,672 square meters (2,000 sy.)
	Moisture-Density Relationship ^{3/}	1 initially and every 20 density tests.
<u>Asphaltic Concrete and Pavements</u> (Non airfield)		
Asphaltic concrete	Marshall method Test	1 test per day minimum and 1 per 907,200 kilograms (1,000 tons) thereafter.
	Specific Gravity	per each Marshall Test.
	Extraction	1 test for each Marshall Method.
	Gradation ^{5/}	1 per each extraction test.

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
	Fracture faces ^{5/}	1 per each extraction test.
Cored or sawed specimens	Perform complete test (thickness, in-place density and bulk specific gravity) on each cored or sawed sample. ^{12/}	Take 1 set of 3 cored sawed specimens for each 836 square meters (1,000 square yards) or fraction thereof. One specimen shall be taken from longitudinal joint or from transverse joint.
<u>Portland Cement Concrete</u> (Non airfield)		
Coarse and Fine Aggregate ^{7/}	Moisture, specific gravity and absorption ^{8/}	1 initially.
	Gradation and fineness modules	1 every 191 cubic meters (250 cy) of concrete.
	Moisture, specific gravity and absorption ^{8/}	(same as coarse aggregate).
Concrete	Slump	Conduct test every day of placement and for every 19 cubic meters (25 cy) and more frequently if batching appears inconsistent. Conduct with strength tests.
	Entrained Air	Conduct with slump test.
	Ambient and concrete temperatures	Conduct with slump tests.
	Unit weight, yield, and water cement ratio	Conduct with strength tests. Check unit weight and adjust aggregate weights to ensure proper yield.
	Flexural strength and evaluation	When specified for slabs on grade or for concrete pavements, take one set of 6 beams every 76 cubic meters (100 cy) of concrete with a minimum of 1 set per day. Two beams shall be tested at 7 days, two at 28 days, and two at 90 days.

<u>Materials</u>	<u>Test</u>	<u>Minimum Sampling and Testing Frequency</u>
	Compressive strength	One set of 3 cylinders per day and every 76 cubic meters (100 cy) for each class of structural concrete. Test one cylinder at 7 days and two at 28 days. Additional field cure cylinders shall be made when insitu strengths are required to be known.
Vibrators	Frequency and amplitude	Check frequency and amplitude initially and any time vibration is questionable.
	Masonry	
Concrete Masonry Units ^{9/}	Dry shrinkage ^{10/}	1 set of 3 per 10,000 units and manufacturers certification and test report.
	Airdry condition ^{11/}	Same as dry shrinkage.
	Absorption	" " " "
	Compressive strength	" " " "
	Unit Weight	" " " "
Mortar and grout	Compressive Strength	1 set of 3, every 2,000 units (1 test at 7 days and 2 tests at 28 days).

NOTES:

- 1/All acceptance tests shall be conducted from in-place samples.
- 2/Additional tests shall be conducted when variations occur due to the contractors operations, weather conditions, site conditions, etc.
- 3/Classification (ASTM D-2487), moisture contents, Atterberg limits and specific gravity tests shall be conducted for each compaction test if applicable.
- 4/Materials to be submitted only upon request by the Contracting Officer.
- 5/Tests can substitute for same tests required under "Aggregates" (from bins or source), although gradations will be required when blending aggregates.
- 6/Increase quantities by 50 percent for Paving mixes and by 100 percent for Government testing of admixtures. Include standard deviation for similar mixes from the intended batch plant and data from a minimum of 30 tests, if available. Refer to ACI 214.
- 7/A petrographic report for aggregate is required with the sample for source approval. If the total amount of all types of concrete is less than 153 cubic meters (200 c.y.) service records from three separate structures in similar environments which used the aggregates may substitute for the petrographic report.
- 8/Aggregate moisture tests are to be conducted in conjunction with concrete strength tests for w/c calculations.
- 9/For less than 1,000 units, the above test may be waived at the discretion of the Contracting Officer and acceptance based on manufacturers certification and test report.
- 10/Additional tests shall be performed when changes are made either in the manufacturing processes or in materials used in the production of the masonry units.
- 11/If adequate storage protection is not provided at the jobsite, additional tests shall be made to determine that the allowable moisture condition has not been exceeded before the blocks can be placed in the structure.
- 12/The nuclear densometer, if properly calibrated, may be used but only in addition to the required testing frequency and procedures using sandcones. The densometer shall be calibrated and is recommended for use when the time for complete results becomes critical.

3. QUALITY CONTROL INSPECTIONS AND RESULTS: (Include a description of preparatory, initial, and/or follow up inspections or meetings; check of subcontractors work and materials delivered to the site compared to submittals and/or specifications; comments on the proper storage of materials; include comments on corrective actions to be taken):

4. QUALITY CONTROL TESTING AND RESULTS (comment on tests and attach test reports):

5. DAILY SAFETY INSPECTIONS (Include comments on new hazards to be added to the Hazard Analysis and corrective action of any safety issues):

6. REMARKS (Include conversations with or instructions from the Government representatives; delays of any kind that are impacting the job; conflicts in the contract documents; comments on change orders; environmental considerations; etc.):

CONTRACTOR'S VERIFICATION: The above report is complete and correct. All material, equipment used, and work performed during this reporting period are in compliance with the contract documents except as noted above.

CONTRACTOR QC REPRESENTATIVE

(Sample of Typical Contractor's Test Report)

TEST REPORT

STRUCTURE OR BUILDING _____

CONTRACT NO. _____

DESCRIPTION OF ITEM, SYSTEM, OR PART OF SYSTEM TESTED:

DESCRIPTION OF TEST: _____

NAME AND TITLE OF PERSON IN CHARGE OF PERFORMING TESTS FOR THE CONTRACTOR:

NAME _____

TITLE _____

SIGNATURE _____

I HEREBY CERTIFY THAT THE ABOVE DESCRIBED ITEM, SYSTEM, OR PART OF SYSTEM HAS BEEN TESTED AS INDICATED ABOVE AND FOUND TO BE ENTIRELY SATISFACTORY AS REQUIRED IN THE CONTRACT SPECIFICATIONS.

SIGNATURE OF CONTRACTOR
QUALITY CONTROL INSPECTOR _____

DATE _____

REMARKS

END OF SECTION

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SECTION 01452

SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(1995) Metric Building Code Requirements for Structural Concrete and Commentary
ACI 530/530.1	(1995) Building Code Requirements for Masonry Structures

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC Pub No. S341	(1997) Seismic Provisions for Structural Steel Buildings
AISC Pub No. S342L	(1993) Load and Resistance Factor Design Specification for Structural Steel Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 435/A 435M	(1990) Straight-Beam Ultrasonic Examination of Steel Plates
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 898/A 898M	(1991) Straight Beam Ultrasonic Examination of Rolled Steel Structural Shapes

FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 302	(Feb 1998) NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures
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1.2 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals not having

a "GA" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-13 Certificates

Special Inspector; GA.

Certification attesting that the Special Inspector is qualified by knowledge and experience to perform the specified Special Inspections. Information, which provides evidence of the knowledge and experience necessary to qualify a person as a Special Inspector for the category of work being certified, will accompany the qualification.

Quality Assurance Plan; GA.

A copy of the Quality Assurance Plan covered by a certificate indicating that the plan meets the content specified in this section.

1.3 SPECIAL INSPECTOR

A Special Inspector shall be used to perform Special Inspections required by this section. The Special Inspector is a person employed by the Contractor and approved by the Government as being qualified by knowledge and experience to perform the Special Inspection for the category of work being constructed. Special Inspectors shall perform their duties independent from the construction quality control staff employed by the Contractor. More than one Special Inspector may be required to provide the varied knowledge and experience necessary to adequately inspect all of the categories of work requiring Special Inspection.

1.4 QUALITY ASSURANCE PLAN

A quality assurance plan shall be developed containing the following:

- a. A list of all items that require quality assurance Special Inspection and testing, including the type, frequency, extent, and duration of the special inspection for each item on this list.
- b. A list of all items that require quality assurance testing, including the type and frequency of testing for each item on this list.
- c. The content, distribution, and frequency of special inspection reports.
- d. The content, distribution, and frequency of testing reports.
- e. The procedures, controls, and people used within the Contractor's organization to develop, sign, and distribute Special Inspection and Testing reports along with the position title and pertinent qualifications of all Contractor personnel involved.

1.5 SPECIAL INSPECTION

The Special Inspection for seismic-resisting system components shall be done as specified. Special Inspector personnel shall be in addition to the quality control inspections and inspectors required elsewhere in this section.

1.5.1 Continuous Special Inspection

Continuous special inspection is the full time observation of the work by the Special Inspector present in the work area whenever work is being performed. Continuous special inspection shall be performed where specified for items as shown on the drawings.

1.5.2 Periodic Special Inspection

Periodic special inspection is the intermittent observation of the work by a Special Inspector present in the work area while work is being performed. The intermittent observation periods shall be at times of significant work, shall be recurrent over the complete work period, and shall total at least 25 percent of the total work time. Periodic special inspection shall be performed where specified for items as shown on the drawings.

PART 2 PRODUCTS NOT USED

PART 3 EXECUTION

3.1 PERFORMANCE OF INSPECTIONS

3.2 Special Inspections shall be performed for the following where designated on the drawings:

3.2.1 Reinforcing Steel

Periodic special inspection during and upon completion of the placement of reinforcing steel in the foundations.

3.2.2 Structural Concrete

Periodic special inspection during and on completion of the placement of concrete for foundation construction.

3.2.3 Structural Steel

a. Continuous special inspection for all structural welding, except the following: periodic special inspection is permitted for single-pass or resistance welds, and welds loaded to less than 50 percent of their design strength, provided the qualifications of the welder and the welding electrodes are inspected at the beginning of the work, and all welds are inspected for compliance with the approved construction documents at the completion of welding.

b. Periodic special inspection in accordance with AISC Pub No. S342L for the installation of bolts in special moment frames.

3.2.4 Architectural Components

Special inspection of the architectural components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the components, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for architectural components shall be as follows:

- a. Periodic special inspection during the erection and fastening of interior non-loadbearing partition walls, exterior non-loadbearing walls, and masonry veneer.
- b. Periodic special inspection during the anchorage of access floors and suspended ceilings.

3.2.5 Mechanical and Electrical Components

Special inspection of the mechanical and electrical components shall assure that the methods of anchoring and fastening indicated on the drawings are being complied with at the onset of construction of the component, and that the specified or shown number, spacing, and types of fasteners were actually installed. Special inspection for mechanical and electrical components shall be as follows:

- a. Periodic special inspection during the anchorage of electrical equipment for emergency or standby power systems.
- b. Periodic special inspection during the installation of anchorage of all other electrical equipment.
- c. Periodic special inspection during installation for flammable, combustible, or highly toxic piping systems and their associated mechanical units.
- d. Periodic special inspection during the installation of HVAC ductwork that will contain hazardous materials.

3.3 TESTING

The special inspector shall be responsible for verifying that the testing requirements are performed by an approved testing agency for compliance with the following, where shown on the drawings:

- a. Reinforcing Steel: Special testing of reinforcing steel shall be as follows:

- (1) Examine certified mill test reports for each shipment of reinforcing steel used in reinforced concrete ordinary frames, boundary members of reinforced concrete shear walls, and reinforced masonry shear walls. The special inspector shall determine conformance with the construction documents.

- (2) Examine the reports for chemical tests, done in accordance with Sec. 3.5.2 of ACI 318M ACI 318/318R, which were performed to determine the weldability of ASTM A 615/A 615M reinforcing steel.

- b. Structural Concrete: Verify that samples of structural concrete obtained at the project site, along with all material components obtained at the batch plant, have been tested in accordance with the requirements of ACI 318M ACI 318/318R and comply with all acceptance provisions contained therein.

- c. Structural Steel:

(1) Verify that all quality assurance testing needed to confirm required material properties contained in Section 05120 STRUCTURAL STEEL has been done in accordance with applicable provisions in AISC Pub No. S341 and AISC Pub No. S342L and that the test results comply with all acceptance provisions contained therein.

(2) When a flange or a plate of steel member with a base metal thickness greater than 38 mm (1.5 inches) is joined by welding so that the flange or plate is subjected to through-thickness weld shrinkage strains, verify that the required ultrasonic testing for discontinuities behind and adjacent to such welds has been done after joint completion. Further verify that any material discontinuities rejected on the basis of the requirements contained in Section 05120 STRUCTURAL STEEL were repaired and were re-tested after the repairs and found acceptable.

3.4 REPORTING AND COMPLIANCE PROCEDURES

a. On the first day of each month, the Contractor shall furnish to the Government five copies of the combined progress reports of the special inspector's observations. These progress reports shall list all special inspections of construction or reviews of testing performed during that month, note all uncorrected deficiencies, and describe the corrections made both to these deficiencies and to previously reported deficiencies. Each monthly report shall be signed by all special inspectors who performed special inspections of construction or reviewed testing during that month, regardless of whether they reported any deficiencies. Each monthly report shall be signed by the Contractor.

b. At completion of construction, each special inspector shall prepare and sign a final report attesting that all work they inspected and all testing and test reports they reviewed were completed in accordance with the approved construction documents and that deficiencies identified were satisfactorily corrected. The Contractor shall submit a combined final report containing the signed final reports of all the special inspectors. The Contractor shall sign the combined final report attesting that all final reports of special inspectors that performed work to comply with these construction documents are contained therein, and that the Contractor has reviewed and approved all of the individual inspector's final reports.

END OF SECTION

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SECTION 01501

CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.1 AVAILABILITY OF UTILITY SERVICES

1.1.1 Water

The Government will make available to Contractor, from existing outlets and supplies, reasonable amounts of potable water without charge. Contractor shall reasonably conserve potable water furnished. Contractor, at its own expense, shall install and maintain necessary temporary connections and distribution lines and shall remove the connections and lines prior to final acceptance of construction.

1.1.2 Electricity

Electric power will be made available by the Government, without charge, to the Contractor for performing work at the work area. The Contractor shall carefully conserve electricity furnished. The Contractor, at its own expense and in a workmanlike manner satisfactory to the Contracting Officer, shall extend the existing electrical distribution system (overhead and underground) for temporary electrical service to the worksite, shall install and maintain necessary temporary connections, and shall remove the same prior to final acceptance of the construction.

1.2 SANITARY PROVISIONS

Contractor shall provide sanitary accommodations for the use of employees as may be necessary and shall maintain accommodations approved by the Contracting Officer and shall comply with the requirements and regulations of the State Health Department, County Sanitarian, or other authorities having jurisdiction.

1.3 TEMPORARY ELECTRIC WIRING

1.3.1 Temporary Power and Lighting

The Contractor shall provide construction power facilities in accordance with the safety requirements of the National Electric Code NFPA No. 70 and the SAFETY AND HEALTH REQUIREMENTS MANUAL EM 385-1-1. The Contractor, or its delegated subcontractor, shall enforce the safety requirements of electrical extensions for the work of subcontractors. Work shall be accomplished by journeyman electricians.

1.3.2 Construction Equipment

In addition to the requirements of SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1, temporary wiring conductors installed for operation of construction tools and equipment shall be either Type TW or THW contained in metal raceways, or shall be hard usage or extra hard usage multiconductor cord. Temporary wiring shall be secured above the

ground or floor in a workmanlike manner and shall not present an obstacle to persons or equipment. Open wiring may only be used outside of buildings, and then only in accordance with the provisions of the National Electric Code.

1.3.3 Submittals

Submit detailed drawings of temporary power connections. Drawings shall include, but not be limited to, main disconnect, grounding, service drops, service entrance conductors, feeders, GFCI'S, and all site trailer connections.

1.4 FIRE PROTECTION

During the construction period, the Contractor shall provide fire extinguishers in accordance with the safety requirements of the SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1. The Contractor shall remove the fire extinguishers at the completion of construction.

1.5 STAGING AREA

Contractor will be provided adequate open staging area as directed by the Contracting Officer. Area is unsecured, and Contractor shall make provisions for its own security.

Contractor shall be responsible for keeping staging area, and office area clean and free of weeds and uncontrolled vegetation growth. Weeds shall be removed by pulling or cutting to within 1-inch of ground level. Lawn areas shall be mown to keep growth to less than 2-inches. All loose debris and material subject to being moved by prevailing winds in the area shall be picked up or secured at all times.

If the area is not maintained in a safe and clean condition as defined above the Contracting Officer may have the area cleaned by others with the costs being deducted from the Contractor's payment.

1.6 HOUSEKEEPING AND CLEANUP

Pursuant to the requirements of Clause CLEANING UP and Clause ACCIDENT PREVENTION, of the CONTRACT CLAUSES, the Contractor shall assign sufficient personnel to ensure compliance. The Contractor shall submit a detailed written plan for implementation of this requirement. The plan will be presented as part of the preconstruction safety plan and will provide for keeping the total construction site, structures, and accessways free of debris and obstructions at all times. Work will not be allowed in those areas that, in the opinion of the Contracting Officer, have unsatisfactory cleanup and housekeeping at the end of the preceding day's normal work shift. At least once each day all areas shall be checked by the Quality Control person of the Contractor and the findings recorded on the Quality Control Daily Report. In addition, the Quality Control person shall take immediate action to ensure compliance with this requirement. Housekeeping and cleanup shall be assigned by the Contractor to specific personnel. The name(s) of the personnel shall be available at the project site.

1.7 DIGGING PERMIT

Before performing any onsite excavation, Contractor shall obtain a digging permit. The digging permit can be obtained at Directorate of Public Works, Building 2012, room 110, telephone

253-967-5237, on weekdays between 8 a.m. and 3:30 p.m. Typically it will take a Contractor 3-5 working days to collect all signatures necessary for clearances prior to the permit being issued.

1.8 CONSTRUCTION NEAR COMMUNICATIONS CABLES

1.8.1 Excavation Near Communication Cables

Digging within .9144 meters (3 feet) of communication cables (including fiber optic cables) shall be performed by hand digging until the cable is exposed. The Contracting Officer shall be notified a minimum 3 days prior to digging within a .9144 meter (3-foot) area near cable. The cable route will be marked by the Government prior to excavation in the area. A digging permit shall be obtained by the Contractor before performing any excavation. The Contractor shall be held responsible for any damage to the cable by excavation procedures. Once the cable is exposed, mechanical excavation may be used if there is no chance of damage occurring to the cable.

1.8.2 Reburial of Exposed Utilities

When existing utility lines are reburied a tape, detectable by pipe detector systems, shall be installed above the uncovered length of the utility at a depth of 305 mm (12 inches) below grade. Tape shall be a minimum .127 mm (5 mil) plastic tape with metallic tracer, minimum 76 mm (3 inches) wide, lettering on tape to show buried utility, and brightly colored.

1.8.3 Access to Communications Manhole or Handhole

No communications manhole or handhole shall be entered without first obtaining a fiber optic cable briefing. Coordinate through the Contracting Officer with USAISC, Fort Lewis, Outside Plant Branch, Cable Section, Bldg. 2682.

1.8.4 Cable Cuts or Damage

If a communications cable is cut or damaged the Contractor shall immediately notify the Contracting Officer (CO) and begin gathering personnel and equipment necessary to repair the cut, or damage. Contractor shall begin repairs within one hour of the cut or damage, unless notified otherwise, and continue repairs without interruption until full service is restored.

1.9 PROJECT SIGN

Contractor shall furnish and install two project signs in accordance with conditions hereinafter specified and layout shown on drawing No. 49s-40-05-15, Sheets 1 and 2, except Corps of Engineers' castle and Department of Army seal will be Government furnished. All letters shall be block type, upper case. Letters shall be painted as indicated using exterior-type paint. Sign shall be maintained in excellent condition throughout the life of job. Project sign shall be located as directed. Upon completion of project, sign shall be removed and shall remain the property of Contractor.

1.10 CONCEALED WORK

All items of work to be concealed shall be Government inspected prior to concealment.

1.11 REPAIR OF ROAD CUTS

Asphaltic surface shall be completely in place within 48 hours after placement of base gravel. Between placement of base gravel and pavement, road shall be kept in driveable and passable condition.

1.12 ELEVATED WORK AREAS

Workers in elevated work areas in excess of 2 meters (6 feet) above an adjoining surface require special safety attention. In addition to the provisions of SAFETY AND HEALTH REQUIREMENTS MANUAL, EM 385-1-1, the following safety measures are required to be submitted to the Contracting Officer's Representative. Prior to commencement of work in elevated work areas, the Contractor shall submit drawings depicting all provisions of his positive fall protection system including, but not limited to, all details of guardrails. Positive protection for workmen engaged in the installation of structural steel and steel joist shall be provided by safety nets, tie-offs, hydraulic man lifts, scaffolds, or other required means. Decking crews must be tied-off or work over nets or platforms not over 2 meters (6 feet) below the work area. Walking on beams and/or girders and the climbing of columns is prohibited without positive protection. Perimeter guardrails shall be installed at floor, roof, or wall openings more than 2 meters (6 feet) above an adjoining surface and on roof perimeters. Rails shall be designed to protect all phases of elevated work including, but not limited to, roofing operations and installation of gutters and flashing. Rails around roofs may not be removed until all work on the roof is complete and all traffic on or across the roof ceases. Rails shall be designed by a licensed engineer to provide adequate stability under any anticipated impact loading. As a minimum, the rails shall consist of a top rail at a height of 1067 mm (42 inches), a mid-rail, and a toe board. Use of tie-offs, hydraulic man lifts, scaffolds, or other means of roof edge protection methods may be utilized on small structures such as family housing, prefabricated metal buildings, etc. If safety belts and harnesses are used, the positive fall protection plan will address fall restraint versus fall arrest. Body belts will ONLY be used for fall restraint, they will not be used for fall arrest.

1.13 TRAFFIC CONTROL PLAN

The Contractor shall submit a Traffic Control Plan for moving traffic through and around the construction zone in a manner that is conducive to the safety of motorists, pedestrians, and workers. This plan shall indicate scheduling, placement, and maintenance of traffic control devices in accordance with the U.S. Department of Transportation, Federal Highway Administration publication, Manual on Uniform Traffic Control Devices. The Contractor shall obtain, in writing, from the Directorate of Public Works (PW) Traffic Engineer, through the Contracting Officer, approval of the Traffic Control Plan. The Contractor shall submit his Traffic Control Plan at least 15 working days prior to commencement of street or road work. Streets (except dead end) may be closed to traffic temporarily (except at least one access lane shall be kept open to traffic) by approved written request to the Contracting Officer at least 10 working days prior to street closure. Excavations shall not remain open for more than 1 working day without approval. The Contractor shall identify by site inspection and indicate on the plan all roads and trails used by military or civilian wheeled and tracked vehicular traffic and, by traffic control devices, prevent this traffic from entering the construction zone.

1.14 UTILITIES NOT SHOWN

The Contractor can expect to encounter, within the construction limits of the entire project, utilities not shown on the drawings and not visible as to the date of this contract. The Contractor shall scan the construction site with electromagnetic or sonic equipment, and mark the surface of the ground where existing utilities are discovered. The Contractor shall verify the elevations of existing utilities, piping and any type of underground obstruction not indicated, or indicated and not specified to be removed. If such utilities interfere with construction operations, he shall immediately notify the Contracting Officer verbally and then in writing to enable a determination by the Contracting Officer as to the necessity for removal or relocation. If such utilities are removed or relocated as directed, the Contractor shall be entitled to equitable adjustment for any additional work or delay. The types of utilities the Contractor may encounter are waterlines, sewer lines (storm and sanitary), gas lines, fueling lines, steam lines, buried fuel tanks, septic tanks, other buried tanks, communication lines, cathodic protection cabling, and power lines. These utilities may be active or abandoned utilities.

1.15 GOVERNMENT WITNESSING AND SCHEDULING OF TESTING

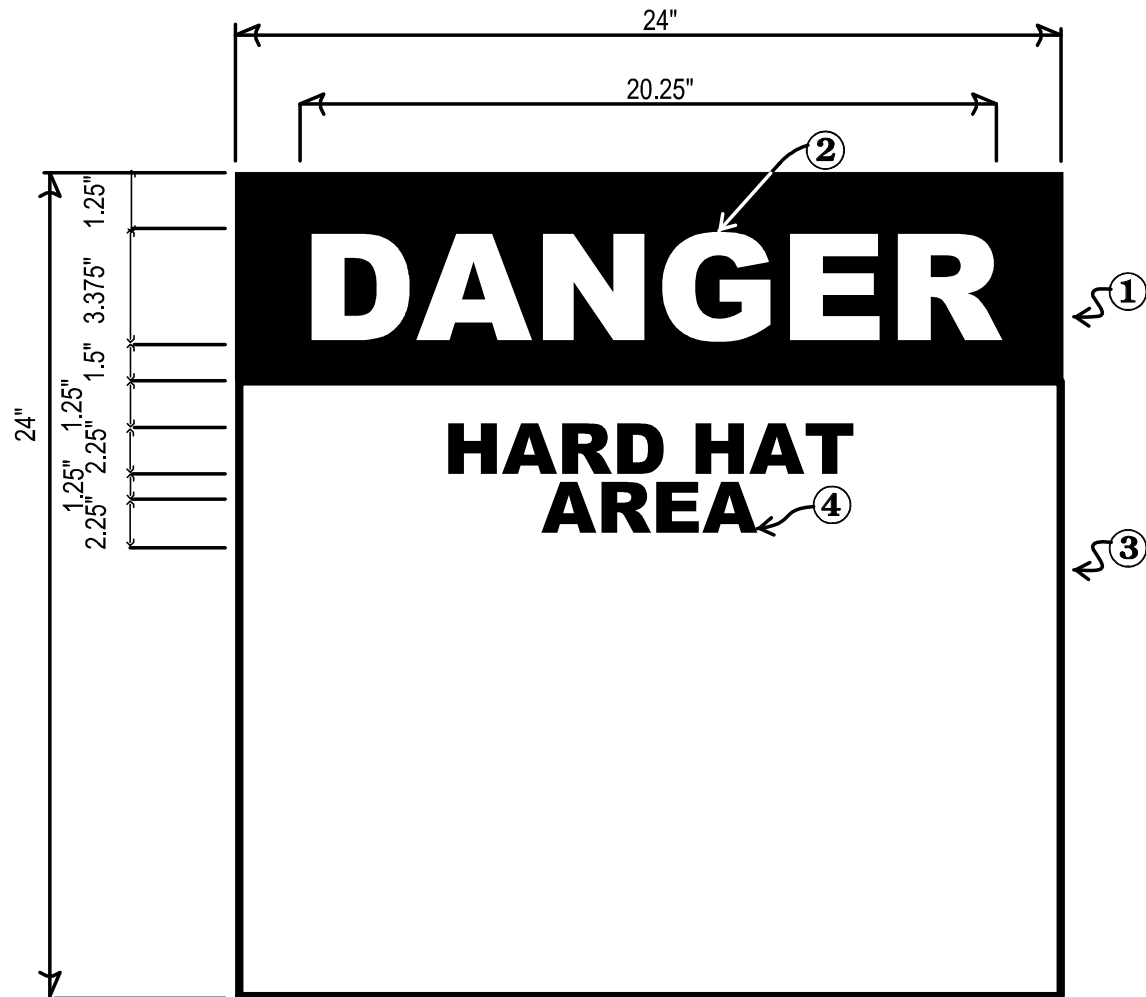
The Contractor shall notify the Contracting Officer, by serial letter, of dates and agenda of all performance testing of the following systems: mechanical (including fire protection and EMCS), electrical (including fire protection) medical and food service systems a minimum of 10 calendar days prior to start of such testing. In this notification, the Contractor shall certify that all equipment, materials, and personnel necessary to conduct such testing will be available on the scheduled date and that the systems have been prechecked by him and are ready for performance and/or acceptance testing. Contractor shall also confirm that all operations and maintenance manuals have been submitted and approved. **NO PERFORMANCE AND/OR ACCEPTANCE TESTING WILL BE PERMITTED UNTIL THE OPERATIONS AND MAINTENANCE MANUALS HAVE BEEN APPROVED.**

Government personnel, at the option of the Government, will travel to the site to witness testing. If the testing must be postponed or canceled for whatever reason not the fault of the government, the Contractor shall provide the Government not less than 3 working days advance notice (notice may be faxed) of this postponement or cancellation. Should this 3 working day notice not be given, the Contractor shall reimburse the Government for any and all out of pocket expenses incurred for making arrangements to witness such testing including, but not limited to airline, rental car, meal, and lodging expenses. Should testing be conducted, but fail and have to be rescheduled for any reason not the fault of the Government, the Contractor shall similarly reimburse the Government for all expenses incurred.

1.16 HARD HAT SIGNS

The Contractor shall provide 610 mm by 610 mm (24 by 24 inch) square Hard Hat Area signs at each entry to the project or work area as directed by the Contracting Officer. A minimum of two signs will be required. Signs shall be in accordance with the sketch at the end of this section.

PART 2 PRODUCTS AND PART 3 EXECUTION (NOT APPLICABLE)



?? SIGN SHALL BE FABRICATED FROM .125 THICK 6061-T6 ALUMINUM PANEL

?? COLOR

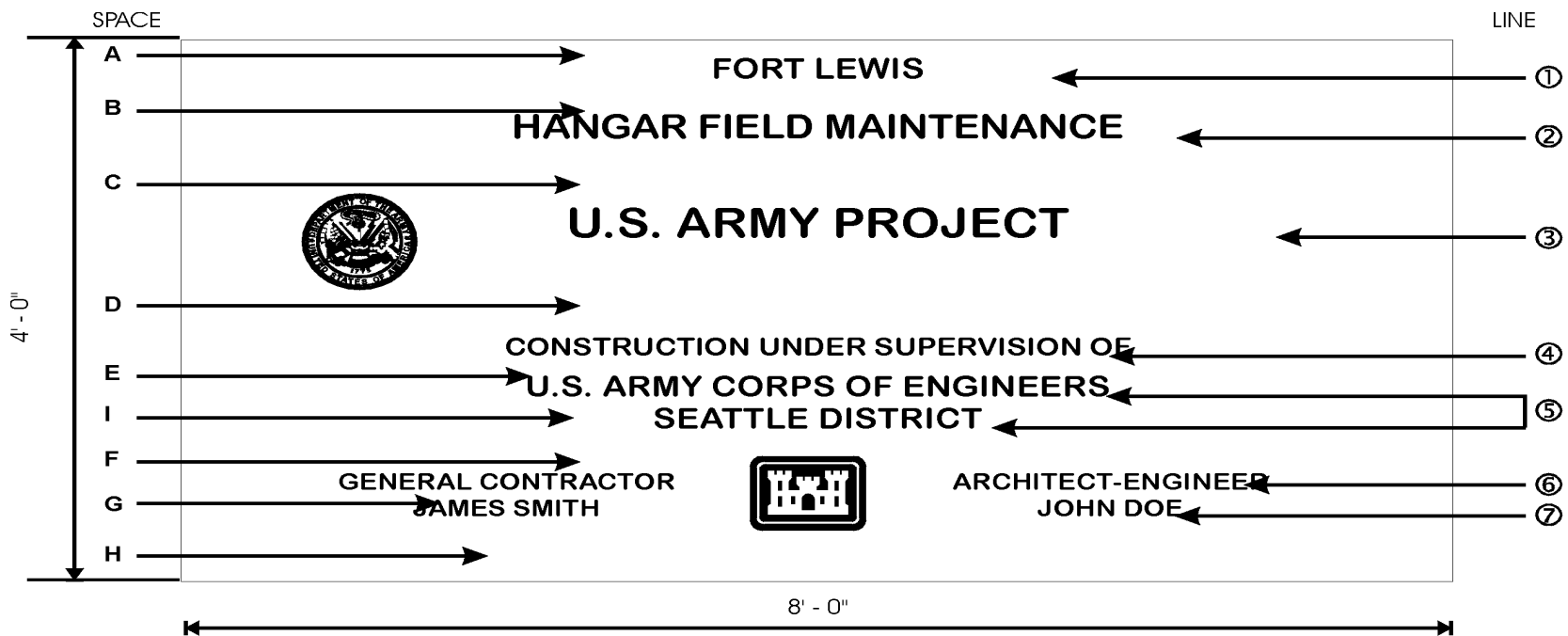
1. SAFETY RED (SR)
2. WHITE
3. WHITE
4. BLACK

?? LETTERING SHALL BE HELVETICA BOLD TYPOGRAPHY.

?? LETTERS AND BACKGROUND SHALL BE REFLECTIVE SHEETING MATERIAL.

?? SIGNS SHALL BE POSTED AT 6'-6" (BOTTOM SIGN TO GRADE) OR AS DIRECTED BY THE CONTRACTING OFFICER.

?? LETTERING TO BE CENTERED ON PANEL.



SAMPLE CONSTRUCTION SIGN FOR MCP PROJECTS SCHEDULE

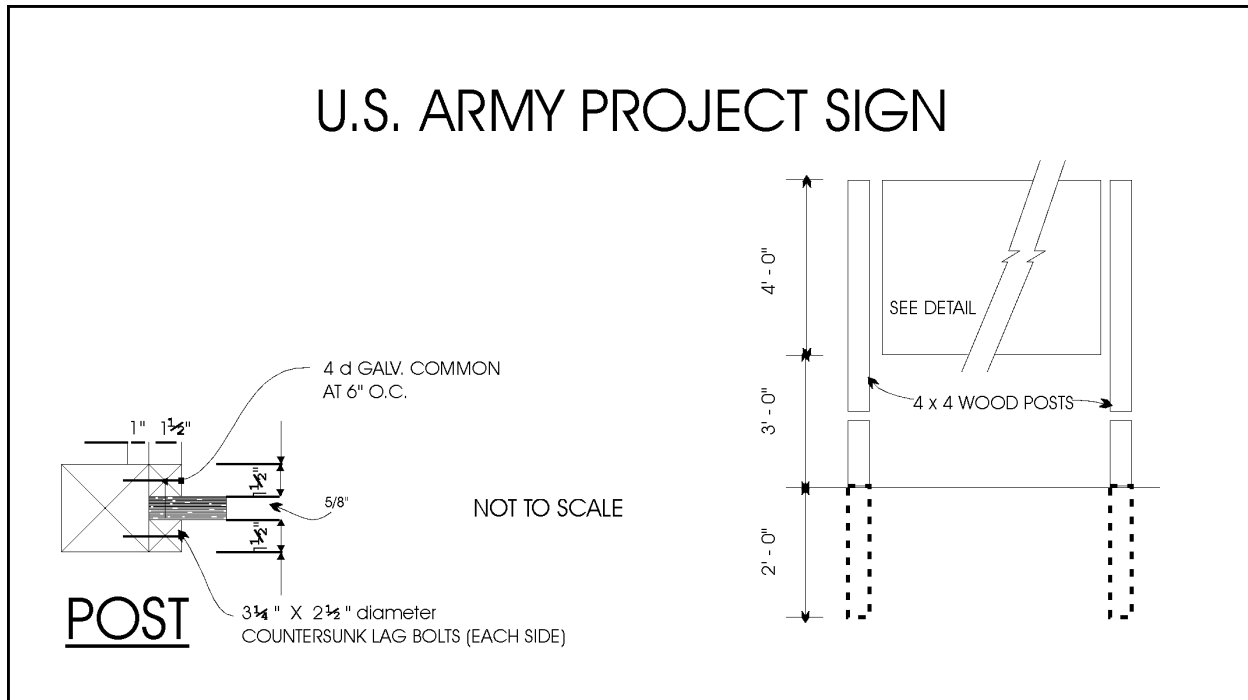
SPACE	HT.	LINE	DESCRIPTION	LETTER HT.	STROKE
A	2"	1	LOCATION	2 3/8"	1/4"
B	2 5/8"	2	PROJECT NOMENCLATURE *	2 3/4"	3/8"
C	5 3/4"	3	U.S. ARMY PROJECT	4"	1/2"
D	8"	4	CONSTRUCTION UNDER SUP.	1 1/2"	1/8"
E	4"	5	CONSTRUCTION AGENCY *	2 3/8"	1/4"
F	4"	6	GENERAL CONTRACTOR *	1 3/8"	3/16"
G	1"	7	GENERAL CONTRACTOR*	1 3/8"	3/16"
H	2 7/8"	*	WILL VARY TO SUIT PROJECT REQUIREMENTS		
I	2		SEATTLE DISTRICT		

U.S. ARMY

**PROJECT
CONSTRUCTION SIGN**

Sheet 1 of 2 Scales As shown
U.S. Army Engr. Dist. Seattle, WA.

Dr: R.L.W. Transmitted with report
Tr: R.L.W. DATED: 20 JUNE 84
Ck: R.L.W. File No. 49s/40-05-15



NOTES:

1. Signboard 4' x 8' x 5/8" grade A-C exterior type plywood with medium density overlay on both sides.
2. Paint both sides and edges with one prime coat and two coats of paint, color white exterior type enamel. Lettering shall be as shown on drawing and shall be black gloss exterior type enamel.
3. Lettering shall be Helvetica medium.
4. Acceptable abbreviations may be used for Contractor's name.
5. Department of Air Force Seal and Corps of Engineers' Castle to be Government furnished.
6. No company logo shall be used.
7. Sign posts and 1½" wood trim shall be painted white.
8. Upon completion of work under this contract, the project sign shall be removed from the job site and shall remain the property of the Contractor.

NOTE: The Contractor shall verify the colors to be used with the Contracting Officer prior to constructing the sign.

SHEET 2 OF 2

END OF SECTION

SECTION 01572

CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT

PART 1 GENERAL

1.1 GOVERNMENT POLICY

Government policy is to apply sound environmental principles in the design, construction and use of facilities. As part of the implementation of that policy the Contractor shall: (1) practice efficient waste management when ordering, sizing, cutting, and installing products and materials, (2) use all reasonable means to avoid the creation of construction and demolition waste (such as minimizing packaging materials and other intermediate products not used in the finished construction) and (3) divert construction and demolition waste from landfills and incinerators and to facilitate their recycling or reuse.

1.2 MANAGEMENT

The Contractor shall take a pro-active, responsible role in the management of construction and demolition waste and require all subcontractors, vendors, and suppliers to participate in the effort. Construction and demolition waste includes products of demolition or removal, excess or unusable construction materials, packaging materials for construction products, and other materials generated during the construction process but not incorporated into the work. In the management of waste consideration shall be given to the availability of viable markets, the condition of the material, the ability to provide the material in suitable condition and in a quantity acceptable to available markets, and time constraints imposed by internal project completion mandates. The Contractor shall be responsible for implementation of any special programs involving rebates or similar incentives related to recycling of waste. Revenues or other savings obtained for salvage, or recycling shall accrue to the Contractor. Firms and facilities used for recycling, reuse, and disposal shall be appropriately permitted for the intended use to the extent required by federal, state, and local regulations.

1.3 PLAN

A waste management plan shall be submitted within 15 days after contract award and prior to initiating any site preparation work. The plan shall include the following:

- a. Name of individuals on the Contractor's staff responsible for waste prevention and management.
- b. Actions that will be taken to avoid and reduce solid waste generation.
- c. Description of the specific approaches to be used in recycling/reuse of the various materials generated, including the areas and equipment to be used for processing, sorting, and temporary storage of wastes.
- d. Characterization, including estimated types and quantities, of the waste to be generated.

- e. Name of landfill(s) and/or incinerator(s) to be used and the estimated costs for use, assuming that there would be no salvage or recycling on the project.
- f. Identification of local and regional reuse programs, including non-profit organizations such as schools, local housing agencies, and organizations that accept used materials such as materials exchange networks and Habitat for Humanity.
- g. List of specific waste materials that will be salvaged for resale, salvaged and reused, or recycled. Recycling facilities that will be used shall be identified. If a recycling facility (public or private) exists within a 50 mile radius of the project site, it use is required for all materials that facility accepts and that cannot be otherwise reused.
- h. Identification of materials that cannot be recycled/reused with an explanation or justification.
- i. Anticipated net cost savings determined by subtracting Contractor program management costs and the cost of disposal from the revenue generated by sale of the materials and the incineration and/or landfill cost avoidance.

1.4 RECORDS

Records shall be maintained to document the quantity of waste generated; the quantity of waste diverted through sale, reuse, or recycling; and the quantity of waste disposed by landfill or incineration. The records shall be made available to the Contracting Officer during construction, and a copy of the records shall be delivered to the Contracting Officer upon completion of the construction.

1.5 COLLECTION

The necessary containers, bins and storage areas to facilitate effective waste management shall be provided and shall be clearly and appropriately identified. Recyclable materials shall be handled to prevent contamination of materials from incompatible products and materials and separated by one of the following methods:

1.5.1 Source Separated Method.

Waste products and materials that are recyclable shall be separated from trash and sorted into appropriately marked separate containers and then transported to the respective recycling facility for further processing.

1.5.2 Co-Mingled Method.

Waste products and recyclable materials shall be placed into a single container and then transported to a recycling facility where the recyclable materials are sorted and processed.

1.5.3 Other Methods.

Other methods proposed by the Contractor may be used when approved by the Contracting Officer.

1.5.4 Mandatory Materials for Collection.

The collection and segregation of certain waste materials is mandatory. These materials shall include: soils, organic materials (clean green), concrete, asphalt, masonry, metals, aluminum, glass, paper, cardboard, recyclable plastics, gypsum board, clean dimensional lumber.

1.5.5 Hazardous Materials.

Any hazardous materials utilized or generated during construction shall not be commingled with reuse/recycle materials. Clearly label hazardous material storage and locate remote from reuse/recycle materials.

1.6 DISPOSAL

Except as otherwise specified in other sections of the specifications, disposal shall be in accordance with the following:

1.6.1 Reuse.

First consideration shall be given to salvage for reuse since little or no re-processing is necessary for this method, and less pollution is created when items are reused in their original form. Sale or donation of waste suitable for reuse shall be considered. Salvaged materials, other than those specified in other sections to be salvaged and reinstalled, shall not be used in this project.

1.6.2 Recycle.

Waste materials not suitable for reuse, but having value as being recyclable, shall be made available for recycling whenever economically feasible.

1.6.3 Waste.

Materials with no practical use or economic benefit shall be disposed at a landfill or incinerator.

1.7 PROJECT WASTE MANAGEMENT REQUIREMENT

The contractor shall salvage or recycle at least 50 percent (by weight) of the generated construction, demolition and land clearing waste.

END OF SECTION

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SECTION 01670

RECYCLED / RECOVERED MATERIALS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Material
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1.2 OBJECTIVES

Government procurement policy is to acquire, in a cost effective manner, items containing the highest percentage of recycled and recovered materials practicable consistent with maintaining a satisfactory level of competition without adversely affecting performance requirements or exposing suppliers' employees to undue hazards from the recovered materials. The Environmental Protection Agency (EPA) has designated certain items which must contain a specified percent range of recovered or recycled materials. EPA designated products specified in this contract comply with the stated policy and with the EPA guidelines. The Contractor shall make all reasonable efforts to use recycled and recovered materials in providing the EPA designated products and in otherwise utilizing recycled and recovered materials in the execution of the work.

1.3 EPA DESIGNATED ITEMS INCORPORATED IN THE WORK

Various sections of the specifications contain requirements for materials that have been designated by EPA as being products which are or can be made with recovered or recycled materials. These items, listed in 40 CFR 247, when incorporated into the work under this contract, shall contain at least the specified percentage of recycled or recovered materials unless adequate justification (non-availability) for non-use is provided. When a designated item is specified as an option to a non-designated item, the designated item requirements apply only if the designated item is used in the work.

1.4 EPA PROPOSED ITEMS INCORPORATED IN THE WORK

The items listed below have been identified by EPA as being products which are still being researched and are being considered for future Comprehensive Procurement Guideline (CPG) designation. It is recommended that these items, when incorporated in the work under this contract, contain the highest practicable percentage of recycled or recovered materials, provided specified requirements are also met.

EPA ITEMS CONSIDERED FOR CPG III DESIGNATION

- Carpet Runners
- Flooring Materials
- Hardboard
- Medium Density Fiberboard
- Nylon Carpet
- Particleboard
- Interior Trim and Window Frames
- Roofing Materials
- Rubberized Asphalt
- Building Blocks
- Decking Material
- Plastic Pipe
- Aggregates
- Concrete Containing Silica Fume

1.5 EPA LISTED ITEMS USED IN CONDUCT OF THE WORK BUT NOT INCORPORATED IN THE WORK

There are many products listed in 40 CFR 247 which have been designated or proposed by EPA to include recycled or recovered materials that may be used by the Contractor in performing the work but will not be incorporated into the work. These products include office products, temporary traffic control products, and pallets. It is recommended that these non-construction products, when used in the conduct of the work, contain the highest practicable percentage of recycled or recovered materials.

END OF SECTION

SECTION 01701

OPERATIONS AND MAINTENANCE MANUALS

PART 1 GENERAL

1.1 SUBMITTALS

Submittals shall be in accordance with SECTION 01330: SUBMITTAL PROCEDURES .

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall provide Operation and Maintenance (O&M) manuals for the complete project as applicable under this contract, including all Contractor furnished and installed equipment, systems and materials, and all Government furnished-Contractor installed equipment, systems and materials. Included herein are requirements for compiling and submitting the O&M data. Additional O&M data requirements are specified in the individual sections of the technical specifications. O & M Manual requirements shall be coordinated with the requirements as stated in the other technical specification sections and shall include listings for spare parts, framed instructions, etc.

3.1.1 PREPARATION

Manual preparation shall be under the direction of an individual or organization that has demonstrated expertise and a minimum of 3 years experience in the preparation of comprehensive and complete O&M manuals. Qualifications shall be submitted for Contracting Officer approval.

3.1.2 FORMAT

3.1.2 O&M data shall be separated into distinct systems. O&M manuals for any particular system shall include narrative and technical descriptions of the interrelations with other systems. This narrative shall include a description on how the system works with notable features of the system, including normal and abnormal operating conditions. The explanation of the system is to be short and concise with reference to specific manufacturer's equipment manuals for details (see paragraph CONTENT, subparagraph b). If the quantity of material is such that it will not fit within one binder then it shall be divided into volumes, as required (see paragraph Binders).

3.1.3 Six copies of the complete set of manuals shall be provided for each building (as identified by a building number or building description) for multi-building projects. For those multi-building projects where the work is identical in each building, one copy of the manual is required for each building plus six additional copies. For those projects that do not have work in specific buildings, six copies of the manuals are required for the complete project. Any project

may have a combination of these requirements to determine the total number of copies required.

3.1.4 The requirement for six copies of the O&M manual shall supersede and replace any requirements for a lesser amount of manuals which may be indicated in some specifications. Each set of manuals shall be tailored for its respective building or facility.

3.2 PRELIMINARY O&M MANUAL AND DATA SUBMITTAL

To establish and assure uniform O&M manual format, the Contractor shall submit two copies of complete set of O & M data without the binders and receive Contracting Officer approval on one (1) of the sets prior to submission of the final bound manuals. Initial O & M Manual data submittal shall be a minimum of 30 days prior to 90 percent project completion.

The Contractor shall also provide two typewritten pages representing the proposed binder marking format as required under Paragraph: Marking and Binding. One page will represent the front cover/spine and the other page will represent the inside of the front cover.

3.2.1 Data submitted for the manual are to be for the specific equipment furnished, and are in addition to that furnished as shop drawings.

3.2.2 The Contracting Officer will require thirty (30) days for review of submitted O&M manual(s) or data. The Contracting Officer will retain one copy of unacceptable O&M manual submittal and return remainder of copies to the Contractor marked "Returned for Correction." If "Returned for Correction." the Contractor shall resubmit the required number of copies of the manual(s) incorporating all comments, prior to substantial completion and/or use and possession. The Contractor may, at his option, update the copy retained by the Government in lieu of providing the added copy.

3.2.3 For equipment or systems requiring personnel training and/or acceptance testing, all O&M data needed for testing shall be approved by the Contracting Officer prior to the scheduling of the training and/or testing. O&Ms in final bound format shall be submitted in a timely manner so all manuals will be approved in the required quantity, prior to the final inspection. Failure to furnish approved, bound manuals in the required quantity by the final inspection may delay the final inspection and will be cause for the Contracting Officer to hold or adjust the retained percentage in accordance with CONTRACT CLAUSE, PAYMENTS UNDER FIXED PRICE CONSTRUCTION CONTRACTS.

3.2.4 Three of the six completed copies of the final O&M manuals (for each building) shall contain original manufacturer's data. Data in the remaining manuals may be duplicated copies of original data. All data furnished must be of such quality to reproduce clear, legible copies.

3.3 BINDERS

3.3.1 Construction and Assembly

Manuals shall be sliding posts or screw-type aluminum binding posts (three screws) with spine, but only one type shall be used for all manuals. The manuals shall be hardback plastic-covered, cleanable, not over 76 mm (3 inches) thick and designed for 216 mm by 279 mm (8-

1/2 by 11 inch) paper. The hard cover shall be of minimum stiffness equal to 2.03 mm (0.080 inch) display board or double weight illustration board.

3.3.2 Marking and Binding

As appropriate, systems shall be grouped into four separate categories and bound into four volumes as follows: Mechanical, Electrical, Fire Alarm/Security, and Architectural/General.

Each binder shall have the following information, as a minimum, inscribed on both the spine and cover using an offset or silk screen printing process; "EQUIPMENT OPERATION, MAINTENANCE, AND REPAIR MANUAL;" BUILDING NAME, IDENTIFICATION NUMBER (Building No.), LOCATION, AND DISCIPLINE (MECHANICAL, ELECTRICAL, FIRE ALARM/SECURITY, ARCHITECTURAL/GENERAL). Contractor's name and address as well as the contract title and contract number shall be printed on the inside of the front cover.

3.3.3 Color

Color of binder and printing shall be the option of the Contractor except that; (a) printing color shall contrast with binder color, and (b) colors shall be the same for all manuals.

3.3.4 Content

The O&M manuals shall be structured to address each of the following topics in order for each system. When the topic does not apply to a particular system the topic name will be included in the manual with the words "DOES NOT APPLY."

a. Warning Page: A warning page shall be provided to warn of potential dangers (if they exist), such as high voltage, toxic chemicals, flammable liquids, explosive materials, carcinogens, or high pressures. The warning page shall be placed inside the front cover, in front of the title page.

b. Index: Each manual shall have a master index at the front identifying all manuals and volumes and subject matter by system name for each. Following the master index, each manual shall have an index of its enclosures listing each volume, tab numbers, etc., as necessary to readily refer to a particular operating or maintenance instruction. Rigid tabbed fly leaf sheets shall be provided for each separate product and/or piece of equipment under each system in the manual. For example, if a system includes Air Handling Units 1 through 5, there shall be tab sheets AHU-1, AHU-2, AHU-3, AHU-4 and AHU-5. When a manual is divided into volumes, each volume shall have a master index at its front, followed by an index for the specific volume listing in detail all enclosed instructions for materials, individual pieces of equipment, and systems. All pages shall be numbered with the referenced number included in the index.

c. Description: Narrative and technical descriptions of the system and of the interrelations with other systems.

d. Check List Prior to Start Up: Precautions and prechecks prior to start up of equipment and/or system, including safety devices, monitoring devices and control sequence shall be provided.

e. Start Up and Operation: Step-by-step sequential procedures for start up and normal operation checks for satisfactory operation shall be provided. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the operating instructions and flagged for the attention of the operator. Procedures shall include test, manual or normal, and automatic modes.

f. Shutdown: Procedures for normal and emergency shutdown of equipment and/or systems shall be provided. The instructions shall include any procedures necessary for placing the equipment and/or system on standby or preparing the equipment and/or system for start up at a later time. Procedures shall include test, manual or normal, and automatic modes.

g. Operator Preventive Maintenance, Major Maintenance, and Adjustments: The instructions shall include recommended operator preventive maintenance which would normally be performed by operating personnel and adjustment procedures necessary for normal operation. Schedules shall be provided indicating time frames or operating hours for initiating operator maintenance and adjustments, and including manufacturer's recommended major maintenance requirements. Emergency adjustments shall be included and flagged for operator's attention; the instructions shall also include procedures for emergency repairs that could be performed by operating personnel. These emergency repairs or "trouble-shooting guides" shall be outlined in three columns with the following headings:

Column 1 - Trouble
Column 2 - Probable Cause(s)
Column 3 - Correction

h. Operator Data: The instructions shall include equipment and/or system layouts showing all piping, wiring, breakers, valves, dampers, controls, etc., complete with diagrams, schematics, isometrics, and data to explain the detailed operation and control of each individual piece of equipment and/or system, including system components. Layouts shall show the location within the facility of controls, valves, switches, dampers, etc., by reference to site location, wing designation, floor, room number, or other clear and concise directions for locating the item. Operator data may be identical to posted data and framed instructions but shall be prepared as part of the O&M manuals. All control systems operations data shall include the following:

(1) A fully labeled control schematic which details all set points, throttling ranges, actions, spans, proportional bands, and any other adjustment.

(2) A fully labeled elementary diagram (ladder diagram).

(3) A sequence of control on the diagrams cross-referenced to the control schematic and elementary diagram.

(4) A generic, functional description of each control component shown on the drawings.

(5) Catalog data of every control device.

i. Electrical Layout Drawings: The Electrical O&M's shall include complete layout drawings and one-line diagrams of exterior and interior electrical with reference to the buildings and site

layout. Drawings shall include layout of interior lighting, interior power, intrusion detection systems, communication systems and fire protection systems. Exterior layout drawings shall show where fed from, pad-mount transformer, metering, main distribution panel and communication lines. Layout drawings shall show the location within the facility or reference to the building and the site plan. Layout drawings shall be half size contract as-built drawings and shall be inserted into plastic pockets and installed at the back of the O&M's that pertain to that particular drawing.

j. Maintenance Procedures: Recommended procedures shall indicate preventive maintenance, lubrication, and good housekeeping practices which should be performed by operating personnel as well as more complex maintenance procedures which would normally be performed by trained maintenance personnel only. The procedures shall be presented with a schedule indicating time frames or operating hours for specific maintenance to be accomplished. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the maintenance procedures and flagged for the attention of personnel. The procedures shall include necessary operating instructions for taking equipment off line, putting equipment on line, or putting equipment on standby. The instructions shall include all necessary material, equipment, and system data to perform maintenance work and shall include, but not be limited to, manufacturers/bulletins, catalogs, and descriptive data; certified performance curves, copies of approved test plans, including logs and records of performance acceptance test results, and actual adjustments made during final acceptance and inspection; system layouts, including block diagrams, wiring, control, and isometric diagrams: schematic items within the facility; and interrelationships with other items of system.

k. Repairs: Repair procedures shall be presented with a step-by-step procedure for locating and correcting the trouble. A "shop manual" may be used for this purpose. Repair procedures shall be keyed to a troubleshooting guide outlined in three columns with the following headings:

Column 1 - Trouble
Column 2 - Probable Cause(s)
Column 3 - Correction

The procedures shall clearly indicate a major repair activity which should only be performed in a shop or factory versus normal repair work that may be performed onsite or with equipment online. The procedures shall also clearly indicate the limit of repair work that may be performed by Government personnel during the warranty period without voiding warranty provisions. Safety precautions and instructions that should be followed during these procedures shall be incorporated into the repair procedures and flagged for the attention of personnel.

l. Tools: The Contractor shall provide one of each nonstandard tool, test instrument, and gauge necessary for performing maintenance and repair work. A nonstandard tool, test instrument, or gauge is defined as an item normally supplied by the manufacturer for the equipment operation or maintenance. The Contractor shall prepare a master list of such items for all equipment and systems and shall key maintenance and repair procedures to this list. The above referenced items for performing maintenance and repair work shall be provided for each individual facility of multifacility projects.

m. Parts and Supplies: A complete list of parts and supplies shall be provided with the maintenance instructions. The list shall include all parts and components of individual pieces of

equipment, and all parts and components of each system and shall identify such items as description of part, model number, circuit or component identification, etc. Parts and supplies lists shall be included within each volume of maintenance instructions. Further, a master list of spare parts and supplies recommended from each manufacturer for 1 year of operation, including source of supply, shall be sublisted with each instruction.

(1) Availability: The Contractor shall list the sources of supply for all parts and supplies, including name of supplier/manufacturer, address, and telephone number. If the parts and supplies are not normally stocked locally, (within 6 hours travel time, round trip by surface transportation) necessary procurement time shall also be a part of the listing.

(2) Spare Parts: The Contractor shall provide those spare parts and supplies that are specified in the TECHNICAL SPECIFICATIONS and those which are normally provided with the equipment or material item. A separate master list shall be provided for these items upon turnover to the Government of the parts and supplies.

n. Maintenance Schedule: A separate schedule of all required periodic maintenance shall be included. This schedule shall list by frequency of occurrence all lubricants and special adjustments required. The types and amounts of lubrication must be specified. The Contractor shall verify that the furnished maintenance schedule agrees with the published manufacturer's data.

3.3.4.1 Architectural/General O&M:

(1) Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Provide information for re-ordering custom manufactured products. Data shall include, but not be limited to, information on carpet, floor tile, vinyl wall finishes, builder's hardware, etc.

(2) Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

(3) Moisture-protection and Weather-exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.

(4) Additional Requirements: As specified in individual specifications sections.

3.3.4.2 Warranties:

In addition to the general warranty required by the contract, the O&M manuals shall include any specific warranties required by other sections of the TECHNICAL SPECIFICATIONS and other warranties normally provided with the particular piece of equipment or system. Extended warranties normally provided by manufacturers that are beyond the warranty of construction shall be specifically noted. The O&M manuals shall also include a specific warranty section itemizing all standard and extended warranty items. The warranty list shall be as indicated below. Warranties will not begin until the facility is accepted by the Contracting Officer. Copy of warranty shall be included in the manual.

WARRANTY INFORMATION

Project Title
Contract Number

General Contractors Name, Phone Number

<u>ITEM DESCRIPTION</u>	<u>START DATE</u>	<u>END DATE</u>	<u>O & M REFERENCE LOCATION</u>
-------------------------	-------------------	-----------------	-------------------------------------

(in alphabetical
order)

Descriptive Name,
Manufactures/
Warrantors Name
Address & Phone No.

3.3.4.3 Installed Equipment Lists:

A copy of the completed Equipment in Place forms required in Section 01705 EQUIPMENT-IN-PLACE -LIST shall be included in the manual. The completed forms shall be located at the front of the catalog and O&M data for the equipment listed on the form.

3.3.4.4 Data Layout:

(1) Data Identification: Catalog data shall be marked to clearly identify pertinent data by highlighting the data with pointers or crossing out all nonpertinent data.

(2) Drawings: All drawings bound in the manuals shall be of such size that will require only one fold made right to left. All larger size drawings shall be inserted into a separate pocket in the required location in the manual. All drawings shall be of microfilm quality.

(3) Posted Data: The Contractor shall provide posted data for equipment or systems, in addition to O&M manuals, and as required by other Technical Specifications sections. The data shall consist of as-built schematics of all wiring, controls, piping, etc., as necessary for the operation of the equipment or system, and a condensed typewritten description of the system. The posted data may include approved shop drawings, layout drawings, riser, and block diagrams and shall indicate all necessary interrelation with other equipment and systems. The data may be presented in one or several frames, under glass or sheet acrylic glazing, for clarity and convenience of location. The framed data presentation and outline shall be acceptable to and posted at locations designated by the Contracting Officer. The data shall be posted before personnel training or performance testing acceptance for the related items of equipment or system.

(4) Framed Instructions: Typewritten instructions, framed under glass or sheet acrylic glazing, explaining equipment or system prestart checkout, startup, operations and shutdown procedures, safety precautions, preventive maintenance procedures, and normal operation checks for satisfactory performance of the equipment of systems shall be posted in conjunction with the posted data. The framed instructions may be presented in one or several frames for clarity and convenience of location. The instruction presentation and outline shall be

acceptable to the Contracting Officer prior to posting, and shall be posted at locations designated by the Contracting Officer. All framed instructions shall be posted before personnel training or performance testing acceptance commences for the related item of equipment or system.

3.3.5 Checklist

Contractor shall complete and initial a copy of the O&M Manual Check List which is provided at the end of this section, and forwarded along with ENG form 4025 as part of the O&M Manual submittal to the Contracting Officer for approval.

O&M MANUAL - REVIEW CHECKLIST

___ Does the manual cover all equipment furnished under the contract? (Review against equipment schedules on the drawings and/or equipment submittals.)

___ Does the manual clearly highlight all relevant portions or cross out all irrelevant portions of catalog data?

___ Does the manual contain operations data for the equipment? (Step-by-step operating instructions, start up procedures, sequences of operation, precautions.)

___ Does the manual contain maintenance and repair data for the equipment? (Lubrication, dismantling, assembly, adjustment, troubleshooting.)

___ Does the manual contain a separate maintenance schedule listed by frequency of occurrence?

___ Does the manual contain parts lists or parts catalogs for the equipment? Parts catalog or list shall contain identification, part numbers, recommended parts to be stocked, and local source of parts.

___ Does the manual contain electrical connection diagrams?

___ Does the manual contain control and interlock system diagrams where applicable?

___ Is every page in the manual numbered and an index provided for ready reference to the data?

___ Is the cover hard (nonflexible) with the facility name, identification number, location, and system embossed on both the spine and cover? Is the Contractor's name and address, and the contract title and contract number embossed on the inside of the manual cover?

___ Is the binding screw posts or sliding post?

___ Is any of the data in the manual under the binding where it cannot be seen?

___ Do three sets of manuals contain all original data sheets and are others clearly legible?

___ Are system layout drawings provided? (Simplified diagrams for the system as installed.)

___ Are all drawings in the manual of such a size that requires one fold right to left, or if a larger size drawing, then inserted into a pocket in the manual?

Note that the above are common requirements to all contracts. Check the specific contract for additional information.

END OF SECTION

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SECTION 01702

AS BUILT RECORDS AND DRAWINGS

PART 1 GENERAL

1.1 SUBMITTALS

Data listed in PART 3 of this section shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES. Due dates shall be as indicated in applicable paragraphs and all submittals shall be completed before final payment will be made.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 AS-BUILT FIELD DATA

3.1.1 General

The Contractor shall keep at the construction site two complete sets of full size blue-line prints of the contract drawings, reproduced at Contractor expense, one for the Contractor's use, one for the Government. During construction, both sets of prints shall be marked to show all deviations in actual construction from the contract drawings. The color red shall be used to indicate all additions and green to indicate all deletions. The drawings shall show the following information but not be limited thereto:

- a. The locations and description of any utility lines and other installations of any kind or description known to exist within the construction area. The location includes dimensions and/or survey coordinates to permanent features.
- b. The locations and dimension of any changes within the building or structure, and the accurate location and dimension of all underground utilities and facilities.
- c. Correct grade or alignment of roads, structures, and utilities if any changes were made from contract plans.
- d. Correct elevations if changes were made in site grading from the contract plans.
- e. Changes in details of design or additional information obtained from working drawings specified to be prepared and/or furnished by the Contractor including, but not limited to, fabrication erection, installation, and placing details, pipe sizes, insulation material, dimensions of equipment foundations, etc.
- f. The topography and grades of all drainage installed or affected as part of the project construction.
- g. All changes or modifications from the original design and from the final inspection.
- h. Where contract drawings or specifications allow options, only the option actually used in the construction shall be shown on the as-built drawings. The option not used shall be deleted.

These deviations shall be shown in the same general detail utilized in the contract drawings. Marking of the prints shall be pursued continuously during construction to keep them up to date. In addition, the Contractor shall maintain full size marked-up drawings, survey notes, sketches, nameplate data, pricing information, description, and serial numbers of all installed equipment. This information shall be maintained in a current condition at all times until the completion of the work. The resulting field-marked prints and data shall be referred to and marked as "As-Built Field Data," and shall be used for no other purpose. They shall be made available for inspection by the Contracting Officer's representative whenever requested during construction and shall be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. Failure to keep the As-Built Field Data (including Equipment-in-Place lists) current shall be sufficient justification to withhold a retained percentage from the monthly pay estimate.

3.1.2 Submittal of the As-Built Field Data

Two sets of the As-Built Field Data shall be submitted to the Contracting Officer for review and approval a minimum of 20 calendar days prior to the date of final inspection. If review of the preliminary as-built drawings reveals errors and/or omissions, the drawings will be returned to the Contractor for corrections. The Contractor shall make all corrections and return the drawings for backcheck to the Contracting Officer within 10 calendar days of receipt. When submitted drawings are accepted, one set of marked drawings will be returned to the Contractor for the completion of the as-built drawings.

3.2 AS-BUILT ELECTRONIC FILE DRAWINGS

3.2.1 No earlier than 30 days after award the Government will have available for the Contractor one set of AutoCAD electronic file format contract drawings, to be used for preparation of as-built drawings. The electronic file drawings will be available on either 89 mm (3-1/2 inch) 1.44 MB floppy disks or ISO-9660 CD-ROM, as directed by the Contracting Officer. The Contractor has 30 days after the receipt of the electronic file to verify the usability of the AutoCAD files, and bring any discrepancies to the attention of the Contracting Officer. Any discrepancies will be corrected within 15 days and files returned to the Contractor. The Contractor shall incorporate all deviations from the original contract drawings as recorded in the approved 'As-built Field Data' (see paragraph 3.1.2). The Contractor shall also incorporate all the written modifications to the contract drawings which were issued by amendment or contract modification. All revisions and changes shall be incorporated, i.e. items marked "deleted" shall be deleted, clouds around new items shall be removed, etc.

3.2.2 No later than 30 days after final acceptance a complete set of as-built drawings shall be submitted in AutoCAD electronic file format. . The electronic file format, layering standards and submittal requirements are specified in paragraphs below. The as-built drawings shall be done in a quality equal to that of the originals. Line work, line weights, lettering, and use of symbols shall be the same as the original line work, line weights, and lettering, and symbols. If additional drawings are required they shall be prepared in electronic file format under the same guidance. When final revisions have been completed, each drawings shall be identified with the words "AS-BUILT" in block letters at least 3/8-inch high placed above the title block if space permits, or if not, below the title block between the border and the trim line. The date of completion and the words "REVISED AS-BUILT" shall be placed in the revision block above the latest revision notation.

3.2.3 Electronic File Submittal Requirements

3.2.3.1 The AutoCAD electronic file(s) deliverable shall be in AutoCAD release 14 'DWG' binary format. All support files required to display or plot the file(s) in the same manner as they were developed shall be delivered along with the files. These files include but are not limited to Font files, Menu files, Plotter Setup, and Referenced files.

3.2.3.2 Layering shall conform to the guidelines defined by the American Institute of Architects (AIA) standard document, "CAD Layer Guidelines", Copyright 1990. An explanatory list of which layer is used at which drawing and an explanatory list of all layers which do not conform to the standard AIA CAD Layer Guidelines including any user definable fields permitted by the guidelines shall be provided with each submittal.

3.2.3.3 Electronic File Deliverable Media:

All electronic files shall be submitted in ISO 9660 format CD-ROM (CD). Zip drive disks shall not be provided. Two complete sets of CD(s) shall be submitted along with one complete set of ½ size prints taken from the CD(s). See paragraph 3.2.4 below. Each CD shall have a clearly marked label stating the Contractor's firm name, project name and location, submittal type (AS-BUILT), and date the CD was made. Each submittal shall be accompanied by a hard copy transmittal sheet that contains the above information along with tabulated information about all files submitted, as shown below:

<u>Electronic File Name</u>	<u>Plate Number</u>	<u>Drawing Title</u>
-----------------------------	---------------------	----------------------

Electronic version of the table shall be included with each submittal set of disks.

3.2.4 Submittal of the Final As-Built Drawings

The final as-built record drawings shall be completed and returned together with the approved preliminary as-built drawings to the COE, Seattle District Office, Technical Branch, Records and Information Section, within 30 calendar days of final acceptance. All drawings from the original contract drawings set shall be included, including the drawings where no changes were made. The Government will review all final as-built record drawings for accuracy and conformance to the drafting standards and other requirements contained in DIVISION 1 GENERAL REQUIREMENTS. The drawings will be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the drawings to the same office within 7 calendar days of receipt.

3.3 All costs incurred by the Contractor in the preparation and furnishing of as-built drawings in electronic file format shall be included in the contract price and no separate payment will be made for this work. Approval and acceptance of the final as-built record drawings shall be accomplished before final payment is made to the Contractor.

3.4 One set of marked-up as-built blueline prints shall be furnished at the time of system acceptance testing. These as-built blueline prints shall be in addition to the submittals of marked-up as-built blueline prints specified elsewhere in the contract.

END OF SECTION

SECTION 01703

WARRANTY OF CONSTRUCTION

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 – SUBMITTAL PROCEDURES:

Warranty Management Plan

One set of the warranty management plan containing information relevant to the warranty of materials and equipment incorporated into the construction project, including the starting date of warranty of construction. The Contractor shall furnish with each warranty the name, address, e-mail address and telephone number of each of the guarantor's representatives nearest to the project location.

Warranty Tags

Two record copies of the warranty tags showing the layout and design.

1.2 WARRANTY MANAGEMENT

1.2.1 Warranty Management Plan

The Contractor shall develop a warranty management plan which shall contain information relevant to the clause Warranty of Construction in SECTION 00700, CONTRACT CLAUSES. At least 30 days before the planned pre-warranty conference, the Contractor shall submit the warranty management plan for Government approval. The warranty management plan shall include all required actions and documents to assure that the Government receives all warranties to which it is entitled. The plan shall be in narrative form and contain sufficient detail to render it suitable for use by future maintenance and repair personnel, whether tradesmen or of engineering background, not necessarily familiar with this contract. The term "status" as indicated below shall include due date and whether item has been submitted or was accomplished. Warranty information made available during the construction phase shall be submitted to the Contracting Officer for approval prior to each monthly pay estimate. Approved information shall be assembled in a binder and shall be turned over to the Government upon acceptance of the work. Information to be turned over to a privatized Utility Contractor shall be separately bound. A joint 4 month and 9 month warranty inspection shall be conducted, measured from time of acceptance, by the Contractor, Contracting Officer and the Customer Representative. Information contained in the warranty management plan shall include, but shall not be limited to, the following:

a. Roles and responsibilities of all personnel associated with the warranty process, including points of contact, telephone numbers and e-mail addresses within the organizations of the Contractors, subcontractors, manufacturers or suppliers involved.

b. Listing and status of delivery of all Certificates of Warranty for extended warranty items, to include roofs, HVAC balancing, pumps, motors, transformers, and for all commissioned systems such as fire protection and alarm systems, sprinkler systems, lightning protection systems, etc.

c. A list for each warranted equipment, item, feature of construction or system indicating:

1. Name of item.
2. Model and serial numbers.
3. Location where installed.
4. Name and phone numbers of manufacturers or suppliers.
5. Names, addresses, e-mail addresses and telephone numbers of sources of spare parts.
6. Warranties and terms of warranty. This shall include one-year overall warranty of construction. Items which have extended warranties shall be indicated with separate warranty expiration dates.
7. Cross-reference to warranty certificates as applicable.
8. Starting point and duration of warranty period.
9. Summary of maintenance procedures required to continue the warranty in force.
10. Cross-reference to specific pertinent Operation and Maintenance manuals.
11. Organization, names, 24-hour emergency phone numbers and e-mail addresses of persons to call for warranty service.
12. Typical response time and repair time expected for various warranted equipment.

d. The Contractor's plans for attendance at the 4 and 9 month post-construction warranty inspections conducted by the Government.

e. Procedure and status of tagging of all equipment covered by extended warranties.

f. Copies of instructions to be posted near selected pieces of equipment where operation is critical for warranty and/or safety reasons.

1.2.2 Performance Bond

The Contractor's Performance Bond shall remain effective throughout the construction period.

a. In the event the Contractor fails to commence and diligently pursue any construction warranty work required, the Contracting Officer will have the work performed by others, and after completion of the work, will charge the expenses incurred by the Government while performing the work, including, but not limited to administrative expenses.

b. In the event sufficient funds are not available to cover the construction warranty work performed by the Government at the Contractor's expense, the Contracting Officer will have the right to recoup expenses from the bonding company.

c. Following oral or written notification by the Contracting Officer or his representative of required construction warranty repair work, the Contractor shall respond in a timely manner. Written verification will follow oral instructions. Failure of the Contractor to respond will be cause for the Contracting Officer to proceed against the Contractor.

1.2.3 Pre-Warranty Conference

Prior to contract completion, and at a time designated by the Contracting Officer, the Contractor shall meet with the Contracting Officer to develop a mutual understanding with respect to the requirements of this section. Communication procedures for Contractor notification of construction warranty defects, priorities with respect to the type of defect, reasonable time required for Contractor response, and other details deemed necessary by the Contracting Officer for the execution of the construction warranty shall be established/reviewed at this meeting. In connection with these requirements and at the time of the Contractor's quality control completion inspection, the Contractor shall furnish the name, telephone number, e-mail address and address of a licensed and bonded company which is authorized to initiate and pursue construction warranty work action on behalf of the Contractor. This point of contact shall be located within the local service area of the warranted construction, shall be continuously available, and shall be responsive to Government inquiry on warranty work action and status. This requirement does not relieve the Contractor of any of its responsibilities in connection with other portions of this contract.

NOTE: Local service area is defined as the area in which the Contractor or his representative can meet the response times as described in paragraph 1.2.4 below and in any event shall not exceed 200 miles radius of the construction site.

1.2.4 Contractor's Response to Construction Warranty Service Requirements

Following oral or written notification by the Government or utility owner, the Contractor shall respond to construction warranty service requirements in accordance with the "Construction Warranty Service Priority List" and the three categories of priorities listed below. The Contractor shall submit a report on any warranty item that has been repaired during the warranty period within two working days of repair completion. The report shall include the cause of the problem, date reported, corrective action taken, and when the repair was completed. Interim status reports shall be submitted weekly on repairs that have not yet been completed. If the Contractor does not perform the construction warranty work within the timeframes specified, the Government will perform the work and backcharge the Contractor.

a. First Priority Code 1 - Safety/Life & Health/Emergency: Perform onsite inspection to evaluate situation and determine course of action within 4 hours, initiate work within 6 hours and work continuously to completion or relief.

b. Second Priority Code 2 – Property Damage/Severe Inconvenience/Urgent: Perform onsite inspection to evaluate situation and determine course of action within 8 hours, initiate work within 24 hours and work continuously to completion or relief.

c. Third Priority Code 3. All other work to be initiated within 3 work days and work continuously to completion or relief.

d. The "Construction Warranty Service Priority List" is as follows (the applicable priority will be determined by the Government in its sole discretion):

Code 1-Air Conditioning Systems

- (1) Recreational support.
- (2) Air conditioning leak in part of building, if causing damage.
- (3) Air conditioning system not cooling properly.

Code 1-Doors

- (1) Overhead doors not operational, causing a security, fire, or safety problem.
- (2) Interior, exterior personnel doors or hardware, not functioning properly, causing a security, fire, or safety problem.

Code 3-Doors

- (1) Overhead doors not operational.
- (2) Interior/exterior personnel doors or hardware not functioning properly.

Code 1-Electrical

- (1) Power failure (entire area or any building operational after 1600 hours).
- (2) Security lights
- (3) Smoke detectors
- (4) Traffic signal blackout

Code 2-Electrical

- (1) Power failure (no power to a room or part of building).
- (2) Receptacle and lights, exit lights or emergency lights (in a room or part of building).
- (3) Traffic signal inoperable (flashing)

Code 3-Electrical

Street lights.

Code 1-Gas

- (1) Leaks and breaks.
- (2) No gas to family housing unit or cantonment area.

Code 1-Heat

- (1). Area power failure affecting heat.
- (2). Heater in unit not working.

Code 2-Kitchen Equipment

- (1) Dishwasher not operating properly.
- (2) Any other equipment hampering preparation of a meal.

Code 1-Plumbing

- (1) Hot water heater failure.
- (2) Leaking water supply pipes.
- (3) Fire sprinkler systems

Code 2-Plumbing

- (1) Flush valves not operating properly.
- (2) Fixture drain, supply line to commode, or any water pipe leaking.
- (3) Commode leaking at base.

Code 3 -Plumbing

Leaky faucets.

Code 3-Interior

- (1) Floors damaged.
- (2) Paint chipping or peeling.
- (3) Casework.

Code 1-Roof Leaks

Temporary repairs shall be made where major damage to property is occurring.

Code 2-Roof Leaks

Where major damage to property is not occurring, check for location of leak during rain and complete repairs on a Code 2 basis.

Code 1-Water (Exterior)

- (1) No water to a building with sanitary facilities.
- (2) Broken water main.

Code 2-Water (Exterior)

No water to facility.

Code 2-Water (Hot)

No hot water in portion of building listed.

Code 1 – Sewerage

- (1) Sewage line backup.
- (2) Broken sanitary or storm sewer main

Code 3-All other work not listed above.

1.2.5 Warranty Tags

At the time of installation, each warranted item shall be tagged with a durable, oil and water resistant tag approved by the Contracting Officer. Each tag shall be attached with a copper wire and shall be sprayed with a silicone waterproof coating. The date of acceptance and the QC signature shall remain blank until project is accepted for beneficial occupancy. The tag shall show the following information.

- a. Type of product/material _____.
- b. Model number _____.
- c. Serial number _____.

- d. Contract number_____.
- e. Warranty period _____ from _____ to _____.
- f. Contractor Inspector's (QC) signature _____.
- g. Construction Contractor _____.
- Address_____.
- Telephone number_____.
- E-mail address _____.
- h. Warranty contact_____.
- Address_____.
- Telephone number_____.
- E-mail address _____.
- i. Warranty response time priority code_____.

END OF SECTION

SECTION 01704
FORM 1354 CHECKLIST

PART 1 GENERAL

1.1 Procedures

The form which is a part of this specification section shall be completed for any project having revisions to real property. The following page contains the basic instructions applicable to the form.

1.2 Submittal

This form shall be submitted for approval, and be approved a minimum of 30 days before final inspection of the project. Failure to have this form completed and approved in time for the final inspection will result in delay of the inspection until the checklist is completed.

PARTS 2 AND 3 NOT USED

INSTRUCTIONS FOR DD FORM 1354 CHECKLIST

The following checklist is only a guide to describe various parts of new and modified construction. Alter this form as necessary or create your own document to give complete accounting of the real property added or deleted for this contract. All items added, deleted, replaced, or relocated within the building 1.5 meter (5 foot line), or on site 1.5 meters (5 feet) beyond the building perimeter must be accounted for completely. Only a few of the most common items beyond the 1.5 meter (5 foot) line are included on the checklist under UTILITIES/SURFACE CONSTRUCTION, add additional items as required by the construction accomplished.. Attach a continuation sheet and use the checklist format to describe other work related to this particular project. Listed on the last page are additional items with units of measure and descriptive terms.

Costs for each item must include material, tax, installation, overhead and profit, bond and insurance costs. This form should be filled out as each item is installed or each phase of work is completed.

TOTAL FOR ALL ITEMS INCLUDING CONTRACT MODIFICATION COSTS ADDED TOGETHER SHOULD EQUAL THE TOTAL CONTRACT PRICE.

NOTE: USE METRIC UNITS OF MEASURE INSTEAD OF ENGLISH UNITS SHOWN.

KEY TO ABBREVIATIONS

AC - Acres
BL - Barrels, Capacity
BTU - British Thermal Unit
CY - Cubic Yards
EA - Each
GA - Gallons, Capacity
HD - Head
kV - Kilovolt-Amperes, Capacity (kVA)
kW - Kilowatts, Capacity
SE - Seats
SF - Square Feet
SY - Square Yard
MB - Million British Thermal Units
MI - Miles
LF - Linear Feet
KG - Thousand Gallons Per Day, Capacity
TN - Ton
- Number; How Many

DD FORM 1354 CHECKLIST
Transfer of Real Property

**CONTRACT
NUMBER:** _____

**CONTRACT
TITLE:** _____

LOCATION: _____

1. **DEMOLITION** (Describe each item removed and the cost of removal.)*

2. **RELOCATION** (Describe each item relocated and the cost of relocation.)*

3. **REPLACEMENTS** (Describe each item replaced and replacement cost.)*

*Use a continuation sheet if more space is required. Items should be described by quantity and the correct unit of measure.

4. NEW CONSTRUCTION OVERVIEW: BUILDING(S)/ADDITION(S) TO A BUILDING - Use a separate checklist for each building and/or addition.

(1) Outside Dimensions: Length x Width

- (a) Main Building _____
- (b) Offsets _____
- (c) Wings _____
- (d) Basement _____
- (e) Attic _____

(2) Number of Usable Floors: _____

(3) Construction: Exterior Materials Used

- (a) Foundation (such as concrete) _____
- (b) Floors (such as wood, concrete) _____
- (c) Walls (such as wood siding, metal, CMU) _____
- (d) Roof (such as metal, comp., built-up) _____

(4) Utilities ENTERING Building: Measure lineal meters (LF) from building entry to next larger size of pipe

- (a) Water (size & type of pipe; number of lineal meters (LF)) _____
- (b) Gas (size & type of pipe; number of lineal meters (LF)) _____
- (c) Sewer (size & type of pipe; number of lineal meters (LF)) _____
- (d) Electric (phase, voltage, size & type of wire, connected load in amps) _____

(5) Air Conditioning:

- (a) Type _____
- (b) _____ Capacity _____ Kilograms
- (TONS) _____
- (c) _____ SQ METERS (SQ YDS) covered by
- system _____

(6) Heating:

- (a) Source _____
- (b) Fuel _____

(7) Hot Water Facilities:

- (a) Capacity Liters (GAL) _____
(b) Temperature Rise _____

BUILDING COST: _____

5. BUILDING SYSTEMS (INTERIOR)

A. FIRE PROTECTION:

Property Code

- (1) (880 50/880-211) CLOSED HEAD AUTO SPRINKLERS - Square Meters (SF) & HD (wet or dry pipe; # of Lineal Meters (LF) of service pipe; type of pipe & # of heads; # of Square Meters (SF) covered by system)

DESCRIPTION:

COST: _____

- (2) (880 50/880-212) OPEN HEAD DELUGE SYSTEM - Square Meters (SF) & HD (# of Lineal Meters (LF) of service pipe; type of pipe; # of heads; # of Square Meters (SF) covered)

DESCRIPTION:

COST: _____

- (3) (880 10/880-221) AUTO FIRE DETECTION SYSTEM - Square Meters (SF) & EA (# of alarms-horns, bells, etc.; # of smoke detectors; # of heat detectors; # of fire alarm panels; # of radio transmitters/antennae)

DESCRIPTION:

COST: _____

- (4) (880 20/880-222) MANUAL FIRE ALARM SYSTEM - EA (# of pull stations; # of alarm horns; # of fire extinguisher cabinets)

DESCRIPTION:

COST: _____

(5) (880 60/880-231) CO2 FIRE SYSTEM (# of bottles & size of bottles in kilograms (lbs.))
DESCRIPTION:

COST: _____

(6) (880 60/880-232) FOAM FIRE SYSTEM - EA (# of tanks - capacity in kilograms (lbs.))
DESCRIPTION:

COST: _____

(7) (880 60/880-233) OTHER FIRE SYSTEM - EA
DESCRIPTION:

COST: _____

(8) (880 60/880-234) HALON 1301 FIRE SYSTEM - EA (# of bottles & size of bottles in kilograms (lbs.))
DESCRIPTION:

COST: _____

B. SECURITY:

(1) (880 40/872-841) SECURITY ALARM SYSTEM - EA (name of system installed)
DESCRIPTION:

COST: _____

C. HEATING/COOLING SYSTEMS

(1) (826 10/890-126) A/C WINDOW UNITS - kilograms (TN) & Square Meters (SF)-(# of units installed; amount of Square Meters (SF) covered per unit; size & capacity of each unit)
DESCRIPTION:

COST: _____

(2) (826 14/890-125) A/C PLT LESS THAN 4,536 kilograms (5 TN) - kilograms (TN) & square meters (SF)-(# of kilograms (TN); # of square meters (SF) covered)

DESCRIPTION:

COST: _____

(3) (826 13/890-121) A/C PLT 4,536 to 22,680 kilograms (5 TO 25 TN) - kilograms (TN)-(# of kilograms (TN); # of square meters (SF) covered)

DESCRIPTION:

COST: _____

(4) (826 12/826-122) A/C PLT 22,680 to 2,267,962 kilograms (25 TO 100 TN) - kilograms (TN)-(# of kilograms (TN); # of square meters (SF) covered)

DESCRIPTION:

COST: _____

(5) (826 11/826-123) A/C PLT OVER 2,267,962 kilograms (100 TN) - kilograms (TN)-(# of kilograms (TN); # of square meters (SF) covered)

DESCRIPTION:

COST: _____

(6) (821 33/821-115) HEATING PLT 220/1026 W (750/3500 MB) - W (MB)-(# of kW (MBH); type of heating system - Ex: Warm air furnace, central)

DESCRIPTION:

COST: _____

(7) (821 32/821-116) HEATING PLT OVER 1026 W (3500 MB) - W(MB)-(# of kW (MBH); type of heating system)

DESCRIPTION:

COST: _____

(8) (811 60/811-147) ELEC EMERGENCY POWER GENERATOR-KW-(size of engine;
rating of generator in kilowatts & voltage)
DESCRIPTION:

COST: _____

(9) (81190 or 82320-gas) STORAGE TANK FOR HEATING or GENERATOR FUEL-Liters
(GA); TYPE; FUEL-(Size, type of tank, kind of fuel & # of liters (gallons))
DESCRIPTION:

COST: _____

(10) (89220/890-272) EMCS – EA (Direct Digital Control Sys)

COST: _____

SITE WORK

6. UTILITIES/SURFACE CONSTRUCTION:

(1) (812 41/812-223) PRIM DISTR LINE OH-Lineal Meters (LF)-(# Lineal Meters (LF) of wire;
size & type of wire; # of poles; voltage)
DESCRIPTION:

COST: _____

(2) (812/81360) TRANSFORMERS-KVA
POWER POLES-Lineal Meters (LF)
(# poles; # transformers - pad or pole mounted; kVA of wire; # Lineal Meters (LF) of wire)
DESCRIPTION:

COST: _____

(3) (812 40/812-224) SEC DISTR LINE OH-Lineal Meters (LF)-(voltage; size & type of wire; # transformers; kVA; # Lineal Meters (LF) of wire; # of service drops; # poles)
DESCRIPTION:

COST: _____

(4) (812 42/812-225) PRIM DISTR LINE UG-Lineal Meters (LF)-(kVA; voltage; type of conduit & size(encased or direct burial); size & kind of wire inside conduit; Lineal Meters (LF) of wire & conduit)
DESCRIPTION:

COST: _____

(5) (812 42/812-226) SEC DISTR LINE UG-Lineal Meters (LF)-(type of conduit & size; type & size of wires in conduit; Lineal Meters (LF) of conduit & wire inside conduit; voltage)
DESCRIPTION:

COST: _____

(6) (812 30/812-926) EXTERIOR LIGHTING-EA-(streets or parking area lights) (# & type of lights; whether pole mounted or not; # Lineal Meters (LF) of connecting wire if pole mounted)
DESCRIPTION:

COST: _____

(7) (824 10/824-464) GAS MAINS-Lineal Meters (LF) (size, type, & # of Lineal Meters (LF) of pipe)
DESCRIPTION:

COST: _____

(8) (831 90/831-169) SEWAGE SEPTIC TANK-thousand liters (KG)-(size, kind of material, & capacity)
DESCRIPTION:

COST: _____

(9) (832 10/832-266) SANITARY SEWER-Lineal Meters (LF)-(sizes & types of pipes - # of Lineal Meters (LF) of each; # of cleanouts; # & size of manholes)

DESCRIPTION:

COST: _____

(10) (842 10/842-245) WATER DISTR MAINS (POTABLE)-Lineal Meters (LF)-(# Lineal Meters (LF) & size, type of pipe)

DESCRIPTION:

COST: _____

(11) (843 11/843-315) FIRE HYDRANTS-EA-(#; size & type)

DESCRIPTION:

COST: _____

(12) (851 90/851-143) CURBS & GUTTERS-Lineal Meters (LF)-(# Lineal Meters (LF); material; width & height)

DESCRIPTION: (Is curb extruded or standard?)_

COST: _____

(13) (851 90/851-145) DRIVEWAY-Square Meters (SY)-Square Meters (SY); material used; thickness)

DESCRIPTION:

COST: _____

(14) (851 10/12/851-147) ROAD-Square Meters (SY) & Lineal Meters (LF)-Square Meters (SY); material used; thickness; Lineal Meters (LF))

DESCRIPTION:

COST: _____

(15) (85210/11 /852-262) VEHICLE PARKING-Square Meters (SY)-Square Meters (SY); material used; thickness; # of bollards; # of wheel stops; # of regular parking spaces; # of handicap spaces)
DESCRIPTION:

COST: _____

(16) (852 20/852-289) SIDEWALKS-Square Meters (SY) & Lineal Meters (LF)-(# Square Meters (SF) & Lineal Meters (LF); dimensions of each section & location; thickness; material used)
DESCRIPTION:

COST: _____

(17) (871 10/871-183) STORM DRAIN DISPOSAL-Lineal Meters (LF)-(# Lineal Meters (LF) of pipe; sizes & types of pipe; # of catch basins & manholes & sizes of each)
DESCRIPTION:

COST: _____

(18) (872 15/872-247) FENCE, SECURITY (ARMS)-Lineal Meters (LF)-(# of Lineal Meters (LF); fence material; # & type of gate(s); # strands of barbed wire on top)
DESCRIPTION:

COST: _____

(19) (87210/12/872-248) FENCE, INTERIOR-Lineal Meters (LF)-(# of Lineal Meters (LF); fence material; # & kind of gate(s)
DESCRIPTION:

COST: _____

(20) (890 70/890-187) UTILITY VAULT(4 or more transformers)- Square Meters (SF) (# Square Meters (SF); dimensions of vault; # of transformers)
DESCRIPTION:

COST: _____

(21) (135 10/135-583) TEL DUCT FACILITY-Lineal Meters (LF)-(# of Lineal Meters (LF); size & type of conduit; type of wire)

DESCRIPTION:

COST: _____

(22) (135 10/135-586) TEL POLE FACILITY-Lineal Meters (LF)-(# Lineal Meters (LF) & type of wire; # of poles)

DESCRIPTION:

COST: _____

7. **INSTALLED EQUIPMENT:** Furnish an Equipment-In-Place List. Any price related to equipment should already be included in this checklist.

8. **SYSTEMS NOT PREVIOUSLY LISTED:** Attach a separate sheet and use the same format to describe the system(s). Example: CATV system, intercom system, or other utilities and surface construction not described on this checklist.

9. **ASBESTOS REMOVAL:** Furnish a description by building of the number of Lineal Meters (LF) of asbestos removed, number of Lineal Meters (LF) of reinsulation, number of Square Meters (SF) of soil encapsulation, and number and size of tanks, etc., where asbestos was removed. Also, identify buildings by their numbers and use.

10. **MAINTENANCE/RENOVATIONS:** List by building number and describe all additions and deletions by quantity and the correct unit of measure. Furnish a cost per building.

UTILITIES/SURFACE CONSTRUCTION - Listed below are some additional items which may or may not apply to your contract. EACH item installed on site should be listed and priced separately even if not included on this checklist.

- (1) IRRIGATION SYSTEM(-Lineal Meters (LF) of pipe; size & type of pipe; number and type of heads)
- (2) UNDERGROUND/ABOVEGROUND STORAGE TANKS(-Liters (GA), type of tank; material stored)
- (3) (833-354) DUMPSTER ENCLOSURE(-Square Meters (SF) & dimensions)
- (4) (890-152) UNLOADING PAD(-Square Meters (SY); material)
- (5) SIGNAGE-(Dimensions; material)
- (6) (12580) CATHODIC PROTECTION(kilometers; Lineal Feet) (MI; LF)
- (7) (87270) LIGHTNING PROTECTION-Lineal Feet (LF)
- (8) (81290) POLE DUCT RISER(-Lineal Feet (LF, type of material)
- (9) RAMPS-Square Meters (SF), material; Cubic Meters (CY) if concrete-use code for sidewalk if concrete)
- (10) (89080/890-158) LOAD AND UNLOAD PLATFORM-Square Meters (SF)
- (11) (83240/832-255) INDUSTRIAL WASTE MAIN-Lineal Meters (LF)
- (12) WHEEL STOPS-(EA; size & material)
- (13) (81350) OUTDOOR INTEGRAL DISTR CTR-(kVA)
- (14) (45110) OUTDOOR STORAGE AREA-Square Meters (SF)
- (15) (73055/730-275) BUS/WAIT SHELTER-Square Meters (SF)
- (16) (690-432) FLAGPOLE-(EA; dimensions)
- (17) (93210) SITE IMPROVEMENT-(JOB)
- (18) (93220) LANDSCAPE PLANTING (Hectare (Acre); EA; Square Meters (SF))
- (19) (93230) LANDSCAPE BERMS/MOUNDS-Square Meters (SY)
- (20) (93410) CUT AND FILL-Cubic Meters (CY)
- (21) (843-315) FIRE HYDRANTS-(EA; Type)
- (22) (14970) LOADING AND UNLOADING DOCKS AND RAMPS (not connected to a building)-Square Meters (SF) (23) BICYCLE RACK-(EA)
- (24) (85140/812-928) TRAFFIC SIGNALS-(EA)
- (25) (87210) FENCING OR WALLS-Lineal Meters (LF)
- (26) (15432) RIPRAP-Lineal Meters & Square Meters (LF & SY)
- (27) (75061) GRANDSTAND OR BLEACHERS-(EA; SE)
- (28) 87150/871-187) RETAINING WALLS-Lineal Meters; Square Meters (LF; SY); material

NOTE: 5 Digit Codes-Army; 6 Digit Codes-Air Force

END OF SECTION

SECTION 01705

EQUIPMENT-IN-PLACE LIST

PART 1 GENERAL

1.1 SUBMITTALS

Data listed in PART 3 of this section shall be submitted in accordance with section 01330 SUBMITTAL PROCEDURES. Due dates shall be as indicated in applicable paragraphs and all submittals shall be completed before final payment will be made.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 Submittal:

The final equipment-in-place list shall be completed and returned to the Contracting Officer within 30 calendar days of the final inspection. The Contracting Officer will review all final Equipment-In-Place Lists for accuracy and conformance to the requirements contained in DIVISION 1 GENERAL REQUIREMENTS. The lists shall be returned to the Contractor if corrections are necessary. The Contractor shall make all corrections and shall return the lists to the Contracting Officer within 7 calendar days of receipt.

3.2 EQUIPMENT-IN-PLACE LIST:

Contractor shall submit for approval, at the completion of construction, a list of equipment-in-place. This list shall be updated and kept current throughout construction, and shall be jointly inspected for accuracy and completeness by the Contracting Officer's representative and a responsible representative of the Contractor prior to submission of each monthly pay estimate. A sample form showing minimum data required is provided at the end of this section. The EQUIPMENT-IN-PLACE LIST shall be comprised of all equipment falling under one or more of the following classifications:

- a. Each piece of equipment listed on the mechanical equipment schedules.
- b. Each electrical panel, switchboard, and MCC panel.
- c. Each transformer.
- d. Each piece of equipment or furniture designed to be movable.
- e. Each piece of equipment that contains a manufacturer's serial number on the name plate.
- f. All Government furnished, Contractor installed equipment per a. through e. (price data excluded)

This information shall be listed in the RMS CQC Module furnished by the Government under the "Installed Property" menu selection.

3.3 PAYMENT:

All costs incurred by the Contractor in the preparation and furnishing of Equipment-In-Place Lists shall be included in the contract price and no separate payment will be made for this work. Approval and acceptance of the final Equipment-In Place Lists shall be accomplished before final payment is made to the Contractor.

EQUIPMENT-IN-PLACE LIST

CONTRACT NO.: _____

Specification Section: _____ Paragraph No. _____

ITEM DESCRIPTION: _____

Item Name: _____

Serial Number: _____

Model Number: _____

Capacity: _____ Replacement Cost _____

ITEM LOCATION:

Building Number: _____ Room Number: _____

or Column Location: _____

MANUFACTURER INFORMATION:

Manufacturer Name: _____

Trade Name (if
different from item name): _____

Manufacturer's Address: _____

Telephone Number: _____

WARRANTY PERIOD: _____

CHECKED BY: _____

END OF SECTION

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SECTION 02220

DEMOLITION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING MANUALS (EM)

EM 385-1-1	(1996) U.S. Army Corps of Engineers Safety and Health Requirements Manual
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1.2 GENERAL REQUIREMENTS

The work includes demolition, salvage of identified items and materials, and removal of resulting rubbish and debris. Rubbish and debris shall be removed from Government property daily, unless otherwise directed, to avoid accumulation at the demolition site. Materials that cannot be removed daily shall be stored in areas specified by the Contracting Officer. In the interest of occupational safety and health, the work shall be performed in accordance with EM 385-1-1, Section 23, Demolition, and other applicable Sections. In the interest of conservation, salvage shall be pursued to the maximum extent possible; salvaged items and materials shall be disposed of as specified.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Work Plan; G

The procedures proposed for the accomplishment of the work. The procedures shall provide for safe conduct of the work, including procedures and methods to provide necessary supports, lateral bracing and shoring when required, careful removal and disposition of materials specified to be salvaged, protection of property which is to remain undisturbed, coordination with other work in progress, and timely disconnection of utility services. The procedures shall include a detailed description of the methods and equipment to be used for each operation, and the sequence of operations in accordance with EM 385-1-1.

1.4 DUST CONTROL

The amount of dust resulting from demolition shall be controlled to prevent the spread of dust to occupied portions of the construction site and to avoid creation of a nuisance in the surrounding area. Use of water will not be permitted when it will result in, or create, hazardous or objectionable conditions such as ice, flooding and pollution.

1.5 PROTECTION

1.5.1 Protection of Personnel

During the demolition work the Contractor shall continuously evaluate the condition of the structure being demolished and take immediate action to protect all personnel working in and around the demolition site. No area, section, or component of floors, roofs, walls, columns, pilasters, or other structural element will be allowed to be left standing without sufficient bracing, shoring, or lateral support to prevent collapse or failure while workmen remove debris or perform other work in the immediate area.

1.5.2 Protection of Structures

Floors, roofs, walls, columns, pilasters, and other structural components that are designed and constructed to stand without lateral support or shoring, and are determined to be in stable condition, shall remain standing without additional bracing, shoring, or lateral support until demolished, unless directed otherwise by the Contracting Officer. The Contractor shall ensure that no elements determined to be unstable are left unsupported and shall be responsible for placing and securing bracing, shoring, or lateral supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.3 Protection of Existing Property

Before beginning any demolition work, the Contractor shall survey the site and examine the drawings and specifications to determine the extent of the work. The Contractor shall take necessary precautions to avoid damage to existing items to remain in place, to be reused, or to remain the property of the Government; any damaged items shall be repaired or replaced as approved by the Contracting Officer. The Contractor shall coordinate the work of this section with all other work and shall construct and maintain shoring, bracing, and supports as required. The Contractor shall ensure that structural elements are not overloaded and shall be responsible for increasing structural supports or adding new supports as may be required as a result of any cutting, removal, or demolition work performed under this contract.

1.5.4 Protection From the Weather

The interior of buildings to remain; salvageable materials and equipment shall be protected from the weather at all times.

1.5.5 Protection of Trees

Trees within the project site limits of work and which are indicated to be left in place, shall be protected by a 1.8 M high portable chain link fence. The fence shall be securely erected at the dripline of individual trees or follow the outer perimeter of branches for clumps of trees. The dripline is defined as the circle drawn on the soil around a tree directly under its

outermost branch tips. If the fence location is in conflict with demolition or construction operations, the Contractor shall bring the conflict to the attention of the CO for resolution. If it is not possible to protect the area within the dripline of trees, the Contractor shall hire a tree specialist (certified arborist, urban forester or horticulturist) to evaluate the condition of the tree and the potential impact to it. The specialist, shall, in consultation with CO, make the final decision on whether the tree shall be removed or retained or if additional protective measures are to be implemented. Any tree designated to remain that is damaged during the work under this contract shall be replaced in kind in accordance with Section 01410 ENVIRONMENTAL PROTECTION or as approved by the Contracting Officer.

1.5.6 Environmental Protection

The work shall comply with the requirements of Section 01410 ENVIRONMENTAL PROTECTION.

1.6 BURNING

The use of burning at the project site for the disposal of refuse and debris will not be permitted.

1.7 USE OF EXPLOSIVES

Use of explosives will not be permitted.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.2 UTILITIES

Existing utilities shall be removed as indicated. When utility lines are encountered that are not indicated on the drawings, the Contracting Officer shall be notified prior to further work in that area.

3.3 FILLING

Holes, open basements and other hazardous openings shall be filled in accordance with Section EARTHWORK.

3.4 DISPOSITION OF MATERIAL

Title to material and equipment to be demolished, except Government salvage and historical items, is vested in the Contractor upon receipt of notice to proceed. The Government will not be responsible for the condition, loss or damage to such property after notice to proceed.

3.4.1 Salvageable Items and Material

Contractor shall salvage items and material to the maximum extent possible.

3.4.1.1 Material Salvaged for the Contractor

Material salvaged for the Contractor shall be stored as approved by the Contracting Officer and shall be removed from Government property before completion of the contract. Material salvaged for the Contractor shall not be sold on the site.

3.4.1.2 Items Salvaged for the Government (NOT APPLICABLE)

3.4.1.3 Items Salvaged for the Using Service (NOT APPLICABLE)

3.4.1.4 Historical Items (NOT APPLICABLE)

3.4.2 Unsalvageable Material

Concrete, masonry, and other noncombustible material, except concrete permitted to remain in place, shall be disposed of outside the limits of Government-controlled land. Combustible material shall be disposed of off the site.

3.5 CLEAN UP

Debris and rubbish shall be removed from basement and similar excavations. Debris shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

3.6 PAVEMENTS

Existing pavements designated for removal shall be saw cut and removed in accordance with the details shown on the drawings and to the limits and depths indicated on the drawings.

END OF SECTION

SECTION 02230

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 DEFINITIONS

1.1.1 Clearing

Clearing shall consist of the felling, trimming, and cutting of trees into sections and the satisfactory disposal of the trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

1.1.2 Grubbing

Grubbing shall consist of the removal and disposal of stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Materials Other Than Salable Timber; Information only

Written permission to dispose of such products on private property shall be filed with the Contracting Officer.

1.3 MEASUREMENT (NOT APPLICABLE)

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 CLEARING

Trees, stumps, roots, brush, and other vegetation in areas to be cleared shall be cut off flush with or below the original ground surface, except such trees and vegetation as may be indicated or directed to be left standing. Existing trees to be preserved shall be crown-pruned to remove all dead, broken, or crossing branches within the crown of the tree. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. Trees to remain shall also have all flagging, paint, hardware, or other man-made products removed prior to new exterior plant material installation. Limbs and branches to be pruned shall be neatly cut just outside the branch collar parallel with the trunk or adjacent larger branch; do not leave stubs. No tree wound dressing or paint shall be used. Trees and vegetation to be

left standing shall be protected from damage incident to clearing, grubbing, and construction operations in accordance with Section 01410 ENVIRONMENTAL PROTECTION and 02220 DEMOLITION.

3.2 GRUBBING

Material to be grubbed, together with logs and other organic or metallic debris not suitable for foundation purposes, shall be removed to a depth of not less than 455 mm below the original surface level of the ground in areas indicated to be grubbed. Tree stumps shall be removed by grinding to a minimum depth of 455mm below original ground surface. In areas indicated as construction areas under this contract, such as areas for buildings, and areas to be paved, removal of unsatisfactory materials is specified in SECTION: 02315, EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS. Depressions made by grubbing shall be filled with suitable material and compacted to make the surface conform with the original adjacent surface of the ground.

3.3 TREE REMOVAL

Where indicated or directed, trees and stumps that are designated as trees shall be removed from areas outside those areas designated for clearing and grubbing. This work shall include the felling of such trees and the removal of their stumps and roots as specified in paragraph GRUBBING. Trees shall be disposed of as specified in paragraph DISPOSAL OF MATERIALS.

3.4 DISPOSAL OF MATERIALS

3.4.1 Salable Timber

3.4.1.1 Salable Timber: Forest products cut on construction sites shall be classified as Sawlogs, Fuelwood, and Trash. Sawlogs and Fuelwood shall be yarded as described below. Trash shall become property of the Contractor.

3.4.1.2 Sawlogs are made from trees that are 200 mm (8 inches) Diameter Breast Height (DBH) (1350 mm (4-1/2 Feet) above ground level) and larger. Cleanly limb trees flush with tree trunk and top at 150 mm (6-inch) Diameter Inside Bark (DIB). The minimum size for a saw log is 150mm (6-inches) diameter on the small end and 4.8M (16-feet) in length.

3.4.1.2.1 If log cannot be handled in one length, buck one or more 9.6 meters (32 foot) logs, plus standard trim allowance 300mm (12-inches), from the butt until the remainder of the tree is less than 9.6 meters (32 feet) in length.

3.4.1.3 Fuelwood is made from trees smaller than 200 mm (8 inches) DBH, and the tops of trees used for sawlogs. Limb tree, or top, and top at 50 mm (2 inches) DIB. The minimum size for a fuel wood log is 125mm (5-inches) diameter on the large end and 2.4M (8-feet) in length.

3.4.1.4 Trash shall be any forest product not classified as sawlogs or fuelwood.

3.4.1.5 Disposition: Yard sawlogs and fuelwood to a local area, as directed by CO, that does not interfere with the construction project and will be accessible at a later date for salvage disposal action. Deck sawlogs and fuelwood separately. All decks, sawlogs, and fuelwood shall be kept

free of limbs and other debris. Trash shall be disposed of in accordance with the following paragraph.

3.4.2 Materials Other Than Salable Timber

Logs, stumps, roots, brush, rotten wood, and other refuse from the clearing and grubbing operations, except for salable timber, shall be disposed of outside the limits of Government-controlled land at the Contractor's responsibility, except when otherwise directed in writing. Such directive will state the conditions covering the disposal of such products and will also state the areas in which they may be placed.

END OF SECTION

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SECTION 02300

EARTHWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1140	(1997) Amount of Material in Soils Finer than the No. 200 (75-micrometer) Sieve
ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 MEASUREMENT (NOT APPLICABLE)

1.3 PAYMENT (NOT APPLICABLE)

1.4 DEFINITIONS

1.4.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified by ASTM D 2487 as GP-GM and SP-SM are satisfactory provided they contain moisture contents suitable for the intended use. Black organic-rich gravel (GM) is satisfactory only for open, seeded, turfed, or other landscaped areas provided they contain moisture contents suitable for the intended use. Satisfactory materials for grading shall be comprised of stones less than 150 mm, except for fill material for pavements which shall be comprised of stones less than 75 mm in any dimension.

1.4.2 Unsatisfactory Materials

Materials which do not comply with the requirements for satisfactory materials are unsatisfactory. Unsatisfactory materials also include man-made fills; trash; refuse; backfills from previous construction; and material classified as satisfactory which contains root and other organic matter or frozen material. The Contracting Officer shall be notified of any contaminated materials.

1.4.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic. Testing required for classifying materials shall be in accordance with ASTM D 4318, ASTM C 136, ASTM D 422, and ASTM D 1140.

1.4.4 Degree of Compaction

Degree of compaction required, except as noted in the second sentence, is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557 abbreviated as a percent of laboratory maximum density. Since ASTM D 1557 applies only to soils that have 30 percent or less by weight of their particles retained on the 9.0 mm (3/4 inch) sieve, the degree of compaction for material having more than 30 percent by weight of their particles retained on the 9.0 mm (3/4 inch) sieve shall be expressed as a percentage of the maximum density in accordance with AASHTO T 180 Method D and corrected with AASHTO T 224. To maintain the same percentage of coarse material, the "remove and replace" procedure as described in the NOTE 8 in Paragraph 7.2 of AASHTO T 180 shall be used.

1.4.5 Overhaul (NOT APPLICABLE)

1.4.6 Topsoil

Topsoil shall be obtained from sources outside the limits of Government-controlled land and shall be as specified in SECTION: 02921, SEEDING.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Earthwork; .

Procedure and location for disposal of unused satisfactory material. Blasting plan when blasting is permitted. Proposed source of borrow material.

Notification of encountering rock in the project. Advance notice on the opening of excavation . Advance notice on shoulder construction for rigid pavements.

SD-06 Test Reports

Testing; .

Within 24 hours of conclusion of physical tests, 2 copies of test results, including calibration curves and results of calibration tests.

SD-07 Certificates

Testing; G

Qualifications of the commercial testing laboratory.

1.6 SUBSURFACE DATA

Subsurface exploration logs are shown on the drawings. These data represent the best subsurface information available; however, variations may exist in the subsurface between boring locations.

1.7 CLASSIFICATION OF EXCAVATION

No consideration will be given to the nature of the materials, and all excavation will be designated as unclassified excavation.

1.8 BLASTING

Blasting will not be permitted.

1.9 UTILIZATION OF EXCAVATED MATERIALS

Unsatisfactory materials removed from excavations shall be disposed of outside the limits of Government-controlled land. Satisfactory material removed from excavations shall be used, insofar as practicable, in the construction of fills, embankments, subgrades, shoulders, bedding (as backfill), and for similar purposes. No satisfactory excavated material shall be wasted without specific written authorization. Satisfactory material authorized to be wasted shall be disposed of outside the limits of Government-controlled land. No excavated material shall be disposed of to obstruct the flow of any stream, endanger a partly finished structure, impair the efficiency or appearance of any structure, or be detrimental to the completed work in any way.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 STRIPPING OF TOPSOIL

Stripping of topsoil will not be required. Topsoil shall be obtained from sources outside the limits of Government-controlled land and shall be defined in SECTION: 02921, SEEDING.

3.2 GENERAL EXCAVATION

The Contractor shall perform excavation of every type of material encountered within the limits of the project to the lines, grades, and elevations indicated and as specified. Grading shall be in conformity with the typical sections shown and the tolerances specified in paragraph FINISHING. Satisfactory excavated materials shall be transported to and placed in fill or embankment within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment shall be disposed of outside the limits of Government-controlled land. Unsatisfactory excavated material shall be disposed of outside the limits of Government-controlled land. During construction, excavation and fill shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation within the grading limits shall be obtained from the borrow areas selected by the Contractor as specified.

3.2.1 Ditches, Gutters, and Channel Changes

Excavation of ditches, gutters, and channel changes shall be accomplished by cutting accurately to the cross sections, grades, and elevations shown. Ditches and gutters shall not be excavated below grades shown. Excessive open ditch or gutter excavation shall be backfilled with satisfactory, thoroughly compacted, material. Material excavated shall be disposed of as shown or as directed, except that in no case shall material be deposited less than 1 meter from the edge of a ditch. The Contractor shall maintain excavations free from detrimental quantities of leaves, brush, sticks, trash, and other debris until final acceptance of the work.

3.2.2 Drainage Structures

Excavations shall be made to the lines, grades, and elevations shown, or as directed. Trenches and foundation pits shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. When concrete or masonry is to be placed in an excavated area, the bottom of the excavation shall not be disturbed. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.3 SELECTION OF BORROW MATERIAL

Borrow material shall be selected to meet the requirements and conditions of the particular fill or embankment for which it is to be used. Borrow material shall be obtained from the borrow areas outside the limits of Government-controlled land. Unless otherwise provided in the contract, the Contractor shall obtain from the owners the right to procure material, pay royalties and other charges involved, and bear the expense of developing the sources, including rights-of-way for hauling.

3.4 OPENING AND DRAINAGE OF EXCAVATION AND BORROW PITS(NOT APPLICABLE)

3.5 GRADING AREAS

Where indicated, work will be divided into grading areas within which satisfactory excavated material shall be placed in embankments, fills, and required backfills. The Contractor shall not haul satisfactory material excavated in one grading area to another grading area except when so directed in writing.

3.6 BACKFILL

Backfill adjacent to any and all types of structures shall be placed and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials to prevent wedging action or eccentric loading upon or against the structure. Ground surface on which backfill is to be placed shall be prepared as specified in paragraph PREPARATION OF GROUND SURFACE FOR EMBANKMENTS. Compaction requirements for backfill materials shall also conform to the applicable portions of paragraphs PREPARATION OF GROUND SURFACE FOR EMBANKMENTS, EMBANKMENTS, and SUBGRADE PREPARATION, and Section 02630 STORM-DRAINAGE SYSTEM; and Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.7 PREPARATION OF GROUND SURFACE FOR EMBANKMENTS

3.7.1 General Requirements

Ground surface on which fill is to be placed shall be stripped of live, dead, or decayed vegetation, rubbish, debris, and other unsatisfactory material; plowed, disked, or otherwise broken up to a depth of 300 mm ; pulverized; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction

shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.

3.7.2 Frozen Material

Embankment shall not be placed on a foundation which contains frozen material, or which has been subjected to freeze-thaw action. This prohibition encompasses all foundation types, including the natural ground, all prepared subgrades (whether in an excavation or on an embankment) and all layers of previously placed and compacted earth fill which become the foundations for successive layers of earth fill. All material that freezes or has been subjected to freeze-thaw action during the construction work, or during periods of temporary shutdowns, such as, but not limited to, nights, holidays, weekends, winter shutdowns, or earthwork operations, shall be removed to a depth that is acceptable to the Contracting Officer and replaced with new material. Alternatively, the material will be thawed, dried, reworked, and recompacted to the specified criteria before additional material is placed. The Contracting Officer will determine when placement of fill shall cease due to cold weather. The Contracting Officer may elect to use average daily air temperatures, and/or physical observation of the soils for his determination. Embankment material shall not contain frozen clumps of soil, snow, or ice.

3.8 EMBANKMENTS

3.8.1 Earth Embankments

Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with any dimension greater than 75 mm. . The material shall be placed in successive horizontal layers of loose material not more than 225 millimeters in depth. Each layer shall be spread uniformly on a soil surface that has been moistened or aerated as necessary, and scarified or otherwise broken up so that the fill will bond with the surface on which it is placed. After spreading, each layer shall be plowed, disked, or otherwise broken up; moistened or aerated as necessary; thoroughly mixed; and compacted to at least 90 percent laboratory maximum density for cohesive materials or 95 percent laboratory maximum density for cohesionless materials. Compaction requirements for the upper portion of earth embankments forming subgrade for pavements shall be identical with those requirements specified in paragraph SUBGRADE PREPARATION. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment.

3.8.2 Rock Embankments (NOT APPLICABLE)

3.9 SUBGRADE PREPARATION

3.9.1 Construction

Subgrade shall be shaped to line, grade, and cross section, and compacted as specified. This operation shall include plowing, disking, and any moistening or aerating required to obtain specified compaction. Soft or otherwise unsatisfactory material shall be removed up to a maximum depth of 750 mm measured from the top of the subgrade and replaced with

satisfactory excavated material or other approved material as directed. Low areas resulting from removal of unsatisfactory material shall be brought up to required grade with satisfactory materials, and the entire subgrade shall be shaped to line, grade, and cross section and compacted as specified. After rolling, the surface of the subgrade for roadways shall not show deviations greater than 10 millimeter when tested with a 3.05 meter straightedge applied both parallel and at right angles to the centerline of the area. The elevation of the finish subgrade shall not vary more than 15 mm from the established grade and cross section.

3.9.2 Compaction

Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Except for paved areas, each layer of the embankment shall be compacted to at least 95 percent of laboratory maximum density.

3.9.2.1 Subgrade for Railroads (NOT APPLICABLE)

3.9.2.2 Subgrade for Pavements

Subgrade for pavements shall be compacted to at least 95 percent of the laboratory maximum density for the depth below the surface of the pavement shown. When more than one soil classification is present in the subgrade, the top 150 mm of subgrade shall be scarified, windrowed, thoroughly blended, reshaped, and compacted.

3.9.2.3 Subgrade for Shoulders

Subgrade for shoulders shall be compacted to at least 95 percentage laboratory maximum density for the full depth of the shoulder.

3.10 SHOULDER CONSTRUCTION

Shoulders shall be constructed of satisfactory excavated or borrow material or as otherwise shown or specified. Shoulders shall be constructed as soon as possible after adjacent paving is complete, but in the case of rigid pavements, shoulders shall not be constructed until permission of the Contracting Officer has been obtained. The entire shoulder area shall be compacted to at least the percentage of maximum density as specified in paragraph SUBGRADE PREPARATION above, for specific ranges of depth below the surface of the shoulder. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, vibratory compactors, or other approved equipment. Shoulder construction shall be done in proper sequence in such a manner that adjacent ditches will be drained effectively and that no damage of any kind is done to the adjacent completed pavement. The completed shoulders shall be true to alignment and grade and shaped to drain in conformity with the cross section shown.

3.11 FINISHING

The surface of excavations, embankments, and subgrades shall be finished to a smooth and compact surface in accordance with the lines, grades, and cross sections or elevations shown. The degree of finish for graded areas shall be within 30 mm of the grades and elevations indicated except that the degree of finish for subgrades shall be specified in

paragraph SUBGRADE PREPARATION. Gutters and ditches shall be finished in a manner that will result in effective drainage. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turfing materials.

3.12 PLACING TOPSOIL

Topsoil shall be placed in accordance with SECTION: 02921, SEEDING.

3.13 TESTING

Testing shall be performed by an approved commercial testing laboratory. Field in-place density shall be determined in accordance with ASTM D 1556, or ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted using only the sand cone method as described in ASTM D 1556. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017; the calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the contracting officer. When test results indicate, as determined by the contracting officer, that compaction is not as specified, the material shall be removed, replaced and recompact to meet specification requirements. Tests on recompact areas shall be performed to determine conformance with specification requirements. Inspections and test results shall be certified by a registered professional civil engineer. These certifications shall state that the tests and observations were performed by or under the direct supervision of the engineer and that the results are representative of the materials or conditions being certified by the tests. Minimum sampling and testing frequency shall be in accordance with section: contractor quality control.

3.14 Subgrade and Embankment Protection

During construction, embankments and excavations shall be kept shaped and drained. Ditches and drains along subgrade shall be maintained to drain effectively at all times. The finished subgrade shall not be disturbed by traffic or other operation and shall be protected and maintained by the Contractor in a satisfactory condition until base, or pavement is placed. The storage or stockpiling of materials on the finished subgrade will not be permitted. No base course, or pavement shall be laid until the subgrade has been checked and approved, and in no case shall base, surfacing, or pavement be placed on a muddy, spongy, or frozen subgrade.

END OF SECTION

SECTION 02315

EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 117:	(1995) Materials Finer than 75 micrometer(No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 136:	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 422:	(1963; R 1990) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1998) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils

1.2 DEGREE OF COMPACTION

Degree of compaction is expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557, abbreviated as percent laboratory maximum density.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-09 Reports

02315/3.9 Borrow Materials; 02315/3.9 G.

02315/2.3 Soil Treatment Agent; 02315/2.3 G.

Certifications, material safety data sheets and manufacturers instructions, not less than 15 days before application of the soil treatment agent. A copy of the pesticide label, Contractor's certification, and application plan including rates of application shall be submitted not less than 15 days before application of the soil treatment agent. All soil treatment submittals shall be approved by Directorate of Public Works (DPW) and the Contracting Officer.

Testing of Backfill Materials; GA

Field Density Tests; GA

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

1.4 SUBSURFACE DATA

Subsurface soil exploration logs are shown on the drawings. This data represents the best subsurface information available, however, variations may exist in the subsurface between exploration locations.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials (Structural Fill)

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified as SP-SM, and GP-GM are also satisfactory provided they contain moisture contents suitable for the intended use. Black organic-rich gravels (GM) shown on the exploration logs are unsatisfactory under buildings and structures with footings and are satisfactory for backfill in open, turfed, seeded, and other landscaped areas only provided they contain moisture contents suitable for the intended use.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials include materials classified in ASTM D 2487 as PT, OH, and OL and any other materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, backfills from previous construction, or having moisture contents unsuitable for the intended use. Unsatisfactory material also includes material classified as satisfactory but which contains root and other organic matter, frozen material, and stones larger than 75 mm. The Contracting Officer shall be notified of any contaminated materials. The black organic-rich gravels (GM) are unsatisfactory under buildings and structures with footings.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM, GP-GM, GW-GM, SW-SM, SP-SM, and SM shall be identified as cohesionless only when the fines are nonplastic. Determination of grain size for classification will be specified to be made in conformance with ASTM C117, ASTM C136, or ASTM D422.

2.1.4 Expansive Soils (NOT APPLICABLE)

2.1.5 Nonfrost Susceptible (NFS) Material (NOT APPLICABLE)

2.2 CAPILLARY WATER BARRIER

Capillary Water Barrier shall consist of clean, crushed, nonporous rock, crushed gravel, or uncrushed gravel. The maximum particle size shall be 37.5 mm and no more than 2 percent by weight shall pass the 4.75 mm size sieve.

2.3 Soil Treatment Agent

Soil treatment agent shall be isofenphos, fenvalerate, cypermethrin, permethrin, or chlorpyrifos as approved by the Directorate of Public Works and the Contracting Officer. Labels shall bear evidence of registration under the Federal Insecticide, and Rodenticide Act and shall provide the manufacturers recommended rates of application.

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

Clearing and grubbing is specified in Section 02230 CLEARING AND GRUBBING. The areas within lines 1.5 m outside of each building and structure line shall be cleared and grubbed of trees, stumps, roots, brush and other vegetation, debris, existing foundations, pavements, utility lines, structures, fences, and other items that would interfere with construction operations. Stumps, logs, roots, and other organic matter shall be completely removed and the resulting depressions shall be filled with satisfactory material, placed and compacted in accordance with paragraph FILLING AND BACKFILLING. Materials removed shall be disposed of outside the limits of Government-controlled property at the Contractor's responsibility.

3.2 TOPSOIL

Topsoil shall be obtained from sources outside the limits of Government-controlled land and shall be as specified in SECTION 02921, SEEDING.

3.3 EXCAVATION

Excavation shall conform to the dimensions and elevations indicated for each building, structure, and footing except as specified, and shall include trenching for utility and foundation drainage systems to a point 1.5 m beyond the building line of each building and structure and all work incidental thereof. Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms. All unsatisfactory materials shall be removed from under buildings, and structures with footings and replaced with satisfactory materials. Under paved areas, unsatisfactory materials shall be removed up to a maximum depth of 750 mm measured from the top of the subgrade and replaced with satisfactory materials. Depths of unsatisfactory materials are indicated on the exploration logs.

During excavation and construction operations foundation materials under buildings and structures shall not be disturbed by heavy construction equipment or other traffic that may cause pumping or rutting of the foundation materials below indicated finish grade. All material disturbed or softened by the Contractor's operations shall be removed, disposed, and replaced with satisfactory materials at the Contractor's expense. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory material encountered below the grades shown shall be removed as directed and replaced with satisfactory material. In the event that it is necessary to remove unsatisfactory material to a depth greater than specified, the Contracting Officer shall be notified and an adjustment in the contract price will be considered in accordance with the contract. Satisfactory material removed below the depths indicated without specific direction of the Contracting Officer shall be replaced at no additional cost to the Government to the indicated excavation grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations. Satisfactory material shall be placed and compacted as specified in paragraph FILLING AND BACKFILLING. Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done under the direction of the Contracting Officer.

3.4 DRAINAGE AND DEWATERING

3.4.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.4.2 Dewatering (NOT REQUIRED)

3.5 SHORING

Shoring, including sheet piling, shall be furnished and installed as necessary to protect workmen, banks, adjacent paving, structures, and utilities. Shoring, bracing, and sheeting shall be removed as excavations are backfilled, in a manner to prevent caving.

3.6 CLASSIFICATION OF EXCAVATION

Excavation will be unclassified regardless of the nature of material encountered

3.7 BLASTING

Blasting will not be permitted.

3.8 UTILITY AND DRAIN TRENCHES

Trenches for underground utilities systems and drain lines shall be excavated to the required alignments and depths. The bottoms of trenches shall be graded to secure the required slope and shall be tamped if necessary to provide a firm pipe bed. Recesses shall be excavated to accommodate bells and joints so that pipe will be uniformly supported for the entire length.

3.9 BORROW

Where satisfactory materials are not available in sufficient quantity from required excavations, approved materials shall be obtained from sources outside the limits of Government-controlled land as specified in Section 02300 EARTHWORK.

3.10 EXCAVATED MATERIALS

Satisfactory excavated material required for structural fill, fill or backfill shall be placed in the proper section of the permanent work required under this section or shall be separately stockpiled if it cannot be readily placed. Satisfactory material in excess of that required for the permanent work and all unsatisfactory material shall be disposed of outside the limits of Government-controlled land.

3.11 FINAL GRADE OF SURFACES TO SUPPORT CONCRETE

Excavation to final grade shall not be made until just before concrete is to be placed.

3.12 SUBGRADE PREPARATION

Unsatisfactory material in surfaces to receive fill or in excavated areas shall be removed up to a maximum depth of 750 mm measured from the top of the subgrade and replaced with satisfactory materials unless directed otherwise by the Contracting Officer. The surface shall be scarified to a depth of 150 mm before the fill is started. Sloped surfaces steeper than 1 vertical to 4 horizontal shall be plowed, stepped, benched, or broken up so that the fill material will bond with the existing material. When subgrades are less than the specified density, the ground surface shall be broken up to a minimum depth of 150 mm, pulverized, and compacted to the specified density. When the subgrade is part fill and part excavation or natural ground, the excavated or natural ground portion shall be scarified to a depth of 300

mm and compacted as specified for the adjacent fill. Material shall not be placed on surfaces that are muddy, frozen, or contain frost. Compaction shall be accomplished by sheepsfoot rollers, pneumatic-tired rollers, steel-wheeled rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used. Minimum subgrade density shall be as specified in paragraph FILLING AND BACKFILLING.

3.13 SOIL TREATMENT

Just prior to placing concrete slab on grade and just prior to backfilling around concrete or masonry foundations for structures, soil treatment shall be applied. The Contractor shall notify and submit to the Contracting Officer and Directorate of Public Works (PDW) at least 15 days in advance before applying the soil treatment as specified in paragraph SUBMITTALS relating to soil treatment agent. Soil treatment agents shall be delivered to the jobsite in sealed and labeled containers bearing the manufacturer's warnings to be observed in the handling and use of soil treatment agents. Labels shall bear evidence of registration under the Federal Insecticide, Fungicide, and Rodenticide Act and shall provide recommended rates of application. Soil treatment agent shall be isofenphos, fenvalerate, cypermethrin, permethrin, or chlorpyrifos in concentrations as recommended by the manufacturer. Other soil treatment agents may be used with prior approval of the Contracting Officer and Directorate of Public Works. Soil treatment agents shall be applied by licensed and certified pest control specialists subject to approval by the Directorate of Public Works and the Contracting Officer.

3.14 FILLING AND BACKFILLING (STRUCTURAL)

Satisfactory materials shall be used in bringing fills and backfills to the lines and grades indicated and for replacing unsatisfactory materials. Satisfactory materials shall be placed in horizontal layers not exceeding 225 mm in loose thickness, or 150 mm when hand-operated compactors are used. After placing, each layer shall be plowed, disked, or otherwise broken up, moistened or aerated as necessary, thoroughly mixed and compacted as specified. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved, forms removed, and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grade. Backfill shall not be placed in wet or frozen areas. Where pipe is coated or wrapped for protection against corrosion, the backfill material up to an elevation 600 mm above sewer lines and 300 mm above other utility lines shall be free from stones larger than 25 mm in any dimension. Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted in layers not more than 100 mm in compacted thickness with power-driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes or tanks to avoid damage to coatings, wrappings, or tanks. Backfill shall not be placed against foundation walls prior to 7 days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall. Each layer of fill and backfill shall be compacted to not less than the percentage of maximum density specified below:

	Percent Laboratory maximum density	
	Cohesive material	Cohesionless material
<u>Fill, embankment, and backfill</u>		
Under structures, building slabs, steps, paved areas, around footings, and in trenches	90	95
Under sidewalks and grassed areas	85	90
<u>Subgrade</u>		
Under building slabs, steps, and paved areas, top 300 mm	90	95
Under sidewalks, top 150 mm	85	90

Compacted subgrades, fills, embankments, and backfills, that are disturbed by the Contractor's operations or by adverse weather before acceptance by the Contracting Officer shall be scarified and compacted at the specified moisture content to the required density before the continuation of construction. Any field density test results indicating the density does not meet specifications shall be followed immediately with a second field density test and a corresponding laboratory quality control test at no additional cost to the Government. The location of the second field density test shall be in the same lift and within 3 meters of the first test and along the direction of travel of the compaction equipment. Should the second field density test also indicate insufficient density, filling or backfilling shall cease in the affected area until all deficiencies have been correction. Inadequate materials shall be removed, reworked, or replaced, compacted and tested at no additional cost to the Government. Recompaction over underground utilities and heating lines shall be by hand tampering. Compaction requirements in trenches shall conform to applicable portions of SECTION: EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.15 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory . Testing facilities and personnel shall meet the requirements of ASTM D 3740 and SECTION: CONTRACTOR QUALITY CONTROL. Field in-place density shall be determined in accordance with ASTM D 1556, ASTM D 2167, or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted if necessary by the procedure described in ASTM D 2922, paragraph ADJUSTING CALIBRATION CURVE. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as

described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed by the Contracting Officer. Moisture density relations shall be determined in accordance with ASTM D 1557. The minimum number of tests, acceptable for each type of operation shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

3.16 CAPILLARY WATER BARRIER

Capillary water barrier under concrete floor and area-way slabs on grade shall be placed directly on the subgrade and shall be compacted with a minimum of two passes of a hand-operated plate-type vibratory compactor. Thickness of the capillary water barrier shall be as shown on the plans.

3.17 GRADING

Areas within 1.5 m outside of each building and structure line shall be constructed true-to-grade, shaped to drain, and shall be maintained free of trash and debris until final inspection has been completed and the work has been accepted.

3.18 SPREADING TOPSOIL

Areas outside the building lines from which topsoil has been removed shall be topsoiled. The surface shall be free of materials that would hinder planting or maintenance operations. The subgrade shall be pulverized to a depth of 50 mm by disking or plowing for the bonding of topsoil with the subsoil. Topsoil shall then be uniformly spread, graded, and compacted to the thickness, elevations, slopes shown, and left free of surface irregularities. Topsoil shall be compacted by one pass of a cultipacker, roller, or other approved equipment weighing 1.46 kN/m to 2.34 kN/m per 300 mm of roller unless otherwise specified in SECTION: SEEDING. Topsoil shall not be placed when the subgrade is frozen, excessively wet, extremely dry, or in a condition otherwise detrimental to seeding, planting, or proper grading.

3.19 PROTECTION

Settlement or washing that occurs in graded, topsoiled, or backfilled areas prior to acceptance of the work, shall be repaired and grades reestablished to the required elevations and slopes.

END OF SECTION

SECTION 02316

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1556	(1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)

1.2 MEASUREMENT AND PAYMENT (NOT APPLICABLE)

1.3 DEGREE OF COMPACTION

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Field Density Tests; GRE
Testing of Backfill Materials; GRE

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Satisfactory Materials

Satisfactory materials shall comprise any materials classified by ASTM D 2487 as GW, GP, SW, and SP. Materials classified as SP-SM, and GP-GM are also satisfactory provided they contain moisture contents suitable for the intended use. Black organic-rich gravels (GM) shown on the exploration logs are unsatisfactory under buildings and structures with footings and are satisfactory for backfill in open, turfed, seeded, and other landscaped areas only provided they contain moisture contents suitable for the intended use.

2.1.2 Unsatisfactory Materials

Unsatisfactory materials include materials classified in ASTM D 2487 as PT, OH, and OL and any other materials which do not comply with the requirements for satisfactory materials. Unsatisfactory materials also include man-made fills, trash, refuse, backfills from previous construction, or having moisture contents unsuitable for the intended use. Unsatisfactory material also includes material classified as satisfactory which contains root and other organic matter, frozen material, and stones larger than 75 mm. The Contracting Officer shall be notified of any contaminated materials. The black organic-rich gravels (GM) are unsatisfactory under buildings and structures with footings and pavements up to a maximum depth of 750 mm measured from the top of the subgrade.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in ASTM D 2487 as GW, GP, SW, and SP. Cohesive materials shall include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM shall be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock (NOT APPLICABLE)

2.1.5 Unyielding Material

Unyielding material shall consist of rock and gravelly soils with stones greater than 75 millimeters inches in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm mesh sieve and no less than 95 percent by weight passing the 25 mm sieve. The maximum allowable aggregate size shall be 75 millimeters, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks 50 millimeters or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than 25 millimeters in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

2.1.9. Drain Gravel

Drain gravel shall be of the type and thickness shown. Drain gravel shall be clean, gravel free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 422.

<u>U.S. Standard Sieve Size</u>	<u>Percent Passing by Weight</u>
37.5 mm(1-1/2 inch)	100
19 mm (3/4 inch)	0-20
10 mm (3/8 inch)	0-2

2.2 PLASTIC MARKING TAPE

Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm (6 inches) wide with minimum thickness of 0.102 mm (0.004 inch). Tape shall have a minimum strength of 12.1 MPa (1750 psi) lengthwise and 10.3 MPa (1500 psi) crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 1 meter deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electric
Yellow:	Gas, Oil, Dangerous Materials
Orange:	Telephone, Telegraph, Television, Police, and Fire Communications
Blue:	Water Systems
Green:	Sewer Systems

PART 3 EXECUTION

3.1 EXCAVATION

Excavation shall be performed to the lines and grades indicated. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 600 mm. Excavated material not required or not satisfactory for backfill shall be removed from the site outside the limits of Government-controlled land. Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation Requirements

The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than 1.2 meters high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm (24 inches) plus pipe outside diameter (OD) for pipes of less than 600 mm (24 inches) inside diameter and shall not exceed 900 mm (36 inches) plus pipe outside diameter for sizes larger than 600 mm (24 inches) inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of 75 millimeters or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

Where unyielding material is encountered in the bottom of the trench, such material shall be removed 100 millimeters below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material

as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the Contractor's fault or neglect in performing the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking, Boring, and Tunneling

Unless otherwise indicated, excavation shall be by open cut except that sections of a trench may be jacked, bored, or tunneled if, in the opinion of the Contracting Officer, the pipe, cable, or duct can be safely and properly installed and backfill can be properly compacted in such sections.

3.1.1.6 DRAINAGE AND DEWATERING

3.1.1.6.1 Drainage

Surface water shall be directed away from excavation and construction sites to prevent erosion and undermining of foundations. Diversion ditches, dikes and grading shall be provided and maintained as necessary during construction. Excavated slopes and backfill surfaces shall be protected to prevent erosion and sloughing. Excavation shall be performed so that the site, the area immediately surrounding the site, and the area affecting operations at the site shall be continually and effectively drained.

3.1.1.6.2 Dewatering

Typically the ground water table is 20 feet below the ground surface with a seasonal fluctuation of 5 feet. Ground water shall not be permitted to accumulate in excavations and shall be dewatered by pumping or other satisfactory methods to prevent detrimental effects to proper construction procedures. Disposal of pumped ground water shall be by pumping into a Contractor-designed dry well or sump system, and discharge of water into existing surface waters will not be permitted due to environmental effects. Operate the dewatering system continuously, 24 hours per day, 7 days per week until such time as construction work below existing water levels is complete, unless directed otherwise. Measure and record the performance of the dewatering system at the same time each day by use of suitable observation wells or piezometers installed in conjunction with the dewatering system. After placement of structures or pipes and backfill, the water level may rise but at no time higher than 600 mm below the prevailing level of excavation or backfill, or 600 mm below the level which would cause flotation of incompletely backfilled structures or pipelines, whichever is lower. Before starting work submit a dewatering plan describing the basic components of the dewatering system proposed and its planned method of operation. Submit the dewatering performance records weekly.

3.1.2 Stockpiles

Stockpiles of satisfactory shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. Locations of stockpiles of satisfactory materials shall be subject to prior approval of the Contracting Officer.

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm loose thickness for compaction by hand operated machine compactors, and 200 mm loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

Trenches shall be backfilled to the grade shown. The trench shall be backfilled to 600 mm above the top of pipe prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 150 mm loose thickness.

3.2.1.3 Bedding and Initial Backfill

Bedding shall be of the type and thickness shown. Bedding shall be clean, sand-gravel mixture free from organic matter and conforming to the following gradation when tested in accordance with ASTM D 422.

U.S. Standard Sieve Size	Percent Passing
25 mm	100
4.75 mm	25-80
0.075 mm	0-10

Initial backfill material shall be placed and compacted with approved tampers to a height of at least 300 mm above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe. Backfill material in this portion of the trench shall consist of satisfactory material at a moisture content that will facilitate compaction, free from stones of such size as recommended by the pipe manufacturer, or larger than 50 mm in any dimension, whichever is smaller, except that where the pipe is coated or wrapped for protection against corrosion, the backfill material shall be free of stones larger than 25 mm in any dimension or as recommended by the pipe manufacturer, whichever is smaller.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways: Backfill shall be placed up to the elevation at which the requirements in Section 02300 EARTHWORK control. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm loose thickness, and compacted to 85 percent maximum density for cohesive soils and 90 percent maximum density for cohesionless soils. Compaction by water flooding or jetting will not be permitted. This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

After the manhole, catchbasin, inlet, or similar structure has been constructed and the concrete has been allowed to cure for 3 days, backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 600 mm of cover. Trenches shall be graded as specified for pipe-laying requirements in Section 02556 GAS DISTRIBUTION SYSTEM.

3.3.2 Water Lines

Trenches shall be of a depth to provide a minimum cover of 1 meter from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe.

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 6.3 mm in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm from the finished grade, unless otherwise indicated. Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.3.5 Plastic Marking Tape

Warning tapes shall be installed directly above the pipe, at a depth of 450 millimeters below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government.

3.4.1 Testing Facilities

Tests shall be performed by an approved commercial testing laboratory.

3.4.2 Testing of Backfill Materials

Classification of backfill materials shall be determined in accordance with ASTM D 2487 and the moisture-density relations of soils shall be determined in accordance with ASTM D 1557. A minimum of one soil classification and one moisture-density relation test shall be performed on each different type of material used for bedding and backfill. Minimum sampling and testing frequency shall be in accordance with SECTION: CONTRACTOR QUALITY CONTROL.

3.4.3 Field Density Tests (NOT APPLICABLE)

3.4.4 Displacement of Sewers

After other required tests have been performed and the trench backfill compacted to the finished grade surface, the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm (36 inches) shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

END OF SECTION

SECTION 02373

SEPARATION/FILTRATION GEOTEXTILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of the specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4354	(1996) Sampling of Geosynthetics for Testing
ASTM D 4355	(1992) Deterioration of Geotextiles from Exposure to Ultraviolet Light and Water (Xenon-Arc Type Apparatus)
ASTM D 4491	(1999) Water Permeability of Geotextiles by Permittivity
ASTM D 4533	(1991; R 1996) Trapezoid Tearing Strength of Geotextiles
ASTM D 4632	(1991; R 1997) Grab Breaking Load and Elongation of Geotextiles
ASTM D 4751	(1999) Determining Apparent Opening Size of a Geotextile
ASTM D 4759	(1988; R 1996) Determining the Specification Conformance of Geosynthetics
ASTM D 4833	(1988; R 1996el) Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products
ASTM D 4873	(1997) Identification, Storage, and Handling of Geosynthetic Rolls

1.2 MEASUREMENT (NOT APPLICABLE)

1.3 PAYMENT (NOT APPLICABLE)

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Manufacturing Quality Control Sampling and Testing;

A minimum of 14 days prior to scheduled use, manufacturer's quality control manual including instructions for geotextile storage, handling, installation, seaming, and repair.

SD-04 Samples

Quality Assurance Samples and Tests;

Samples for quality assurance testing; 7 days shall be allotted in the schedule to allow for testing.

SD-06 Test Reports

SD-07 Certificates

Geotextile; GRE

A minimum of 14 days prior to scheduled use, manufacturer's certificate of compliance stating that the geotextile meets the requirements of this section. This submittal shall include copies of manufacturer's quality control test results. For needle punched geotextiles, the manufacturer shall also certify that the geotextile has been continuously inspected using permanent on-line full-width metal detectors and does not contain any needles which could damage other geosynthetic layers. The certificate of compliance shall be attested to by a person having legal authority to bind the geotextile manufacturer.

1.5 DELIVERY, STORAGE AND HANDLING

Delivery, storage, and handling of geotextile shall be in accordance with ASTM D 4873.

1.5.1 Delivery

The Contracting Officer will be present during delivery and unloading of the geotextile. Rolls shall be packaged in an opaque, waterproof, protective plastic wrapping. The plastic wrapping shall not be removed until deployment. If quality assurance samples are collected, rolls shall be immediately rewrapped with the plastic wrapping. Geotextile or plastic wrapping damaged during storage or handling shall be repaired or replaced, as directed. Each roll shall be labeled with the manufacturer's name, geotextile type, roll number, roll dimensions (length, width, gross weight), and date manufactured.

1.5.2 Storage

Geotextile rolls shall be protected from becoming saturated. Rolls shall either be elevated off the ground or placed on a sacrificial sheet of plastic. The geotextile rolls shall also be protected from the following: construction equipment, ultraviolet radiation, chemicals, sparks and flames, temperatures in excess of 71 degrees C, and any other environmental condition that may damage the physical properties of the geotextile.

1.5.3 Handling

Geotextile rolls shall be handled and unloaded with load carrying straps, a fork lift with a stinger bar, or an axial bar assembly. Rolls shall not be dragged along the ground, lifted by one end, or dropped to the ground.

PART 2 PRODUCTS

2.1 RAW MATERIALS

2.1.1 Geotextile

Geotextile shall be a nonwoven pervious sheet of polymeric material and shall consist of long-chain synthetic polymers composed of at least 95 percent by weight polyolefins, polyesters, or polyamides. The use of woven slit film geotextiles (i.e. geotextiles made from yarns of a flat, tape-like character) will not be allowed. Stabilizers and/or inhibitors shall be added to the base polymer, as needed, to make the filaments resistant to deterioration by ultraviolet light, oxidation, and heat exposure. Regrind material, which consists of edge trimmings and other scraps that have never reached the consumer, may be used to produce the geotextile. Post-consumer recycled material shall not be used. Geotextile shall be formed into a network such that the filaments or yarns retain dimensional stability relative to each other, including the selvages. Geotextiles and factory seams shall meet the requirements specified in Table 1. Where applicable, Table 1 property values represent minimum average roll values (MARV) in the weakest principal direction. Values for AOS represent maximum average roll values.

TABLE 1. GEOTEXTILE PHYSICAL PROPERTIES

PROPERTY	TEST VALUE	TEST METHOD
Elongation at Break, percent	Greater Than 50	ASTM D 4632
Apparent Opening Size (U.S. Sieve)	_60_	ASTM D 4751
Permittivity, sec-1	0.2	ASTM D 4491
Puncture, N	250	ASTM D 4833
Grab Tensile, N	700	ASTM D 4632
Trapezoidal Tear, N	250	ASTM D 4533
Ultraviolet Stability (percent strength retained at 500 hours)	50	ASTM D 4355

2.1.2 Thread

Sewn seams shall be constructed with high-strength polyester, nylon, or other approved thread type. Thread shall have ultraviolet light stability equivalent to the geotextile and the color shall contrast with the geotextile.

2.2 MANUFACTURING QUALITY CONTROL SAMPLING AND TESTING

Manufacturing quality control sampling and testing shall be performed in accordance with the manufacturer's approved quality control manual. As a minimum, geotextiles shall be randomly sampled for testing in accordance with ASTM D 4354, Procedure A. Acceptance of geotextile shall be in accordance with ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

PART 3 EXECUTION

3.1 QUALITY ASSURANCE SAMPLES AND TESTS

3.1.1 Quality Assurance Samples

The Contractor shall provide assistance to the Contracting Officer in the collection of quality assurance samples. Samples shall be collected upon delivery to the site for quality assurance testing at the request of the Contracting Officer. Lot size for quality assurance sampling shall be considered to be the shipment quantity of the product or a truckload of the product, whichever is smaller. The unit size shall be considered one roll of geotextile. Samples shall be identified with a waterproof marker by manufacturer's name, product identification, lot number, roll number, and machine direction. The date and a unique sample number shall also be noted on the sample. The outer layer of the geotextile roll shall be discarded prior to sampling a roll. Samples shall then be collected by cutting the full-width of the geotextile sheet a minimum of 1 meter long in the machine direction. Rolls which are sampled shall be immediately rewrapped in their protective covering.

3.1.2 Quality Assurance Tests

The Contracting Officer may provide quality assurance samples to an Independent Laboratory hired by the Government. Samples will be tested to verify that geotextile meets the requirements specified in Table 1. Test method ASTM D 4355 shall not be performed on the collected samples. Geotextile product acceptance shall be based on ASTM D 4759. Tests not meeting the specified requirements shall result in the rejection of applicable rolls.

3.2 INSTALLATION

3.2.1 Subgrade Preparation

The surface underlying the geotextile shall be smooth and free of ruts or protrusions which could damage the geotextile. Subgrade materials and compaction requirements shall be in accordance with Section 02300, EARTHWORK.

3.2.2 Placement

The Contractor shall request the presence of the Contracting Officer during handling and installation. Geotextile rolls which are damaged or contain imperfections shall be repaired or replaced as directed. The geotextile shall be laid flat and smooth so that it is in direct contact with the subgrade. The geotextile shall also be free of tensile stresses, folds, and wrinkles. On slopes greater than 5 horizontal on 1 vertical, the geotextile shall be laid with the machine direction of the fabric parallel to the slope direction.

3.3 SEAMS

3.3.1 Overlap Seams

Geotextile panels shall be continuously overlapped a minimum of 300 mm. Where it is required that seams be oriented across the slope, the upper panel shall be lapped over the lower panel. The Contractor has the option of field sewing instead of overlapping.

3.3.2 Sewn Seams (NOT APPLICABLE)

3.4 PROTECTION

The geotextile shall be protected during installation from clogging, tears, and other damage. Damaged geotextile shall be repaired or replaced as directed. Adequate ballast (e.g. sand bags) shall be used to prevent uplift by wind. The geotextile shall not be left uncovered for more than 7 days during installation.

3.5 REPAIRS

Geotextile damaged during installation shall be repaired by placing a patch of the same type of geotextile which extends a minimum of 300 mm beyond the edge of the damage or defect. Patches shall be continuously fastened using a sewn seam or other approved method. The machine direction of the patch shall be aligned with the machine direction of the geotextile being repaired. Geotextile which cannot be repaired shall be replaced.

3.6 PENETRATIONS

Engineered penetrations of the geotextile shall be constructed by methods recommended by the geotextile manufacturer.

3.7 COVERING

Geotextile shall not be covered prior to approval by the Contracting Officer. The Contractor shall request the presence of the Contracting Officer during covering of the geotextile. Cover soil requirements are described in Section 02316, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. The direction of backfilling shall proceed in the direction of down gradient shingling of geotextile overlaps. However, on side slopes, soil backfill shall be placed from the bottom of the slope upward. Cover soil shall be placed in a manner that prevents soil from entering the geotextile overlap zone, prevents tensile stress from being mobilized in the geotextile, and prevents wrinkles from folding over onto themselves. No equipment shall be operated directly on top of the geotextile. A minimum of 305mm of soil shall be maintained between full-scale construction equipment tires/tracks and

the geotextile during the covering process. Compaction and testing requirements for cover soil are described in Section 02316, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

END OF SECTION

SECTION 02510

WATER DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 1483	(1998) Oriented Poly(Vinyl Chloride), PVCO, Pressure Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1992) Hypochlorites
AWWA B301	(1992) Liquid Chlorine

AWWA C110	(1993) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids
AWWA C502	(1994; C502a) Dry-Barrel Fire Hydrants
AWWA C651	(1992) Disinfecting Water Mains
AWWA C700	(1995) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C900	(1997; C900a) Polyvinyl Chloride (PVC) Pressure Pipe, 4 In. Through 12 In., for Water Distribution
AWWA C901	(1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service
AWWA C905	(1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 14 In. Through 36 In.
AWWA C909	(1998) Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe, 4 IN through 12 IN (100 mm through 300 mm), for Water Distribution

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
FITTINGS INDUSTRY (MSS)

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 49	(1994) Hazardous Chemicals Data
NFPA 325-1	(1994) Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids

NSF INTERNATIONAL (NSF)

NSF 14	(1998) Plastics Piping Components and Related Materials
NSF 61	(1999) Drinking Water System Components - Health Effects (Sections 1-9)

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 21	(1991) White or Colored Silicone Alkyd Paint
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SSPC Paint 25

(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)

1.2 PIPING

This section covers water distribution lines, and connections to building service at a point approximately 1.5 m outside buildings and structures to which service is required. The Contractor shall have a copy of the manufacturer's recommendations for each material or procedure to be utilized available at the construction site at all times.

1.2.1 Distribution Lines 80 mm or Larger

Piping for water distribution lines 80 mm or larger shall be ductile iron, polyvinyl chloride (PVC) through 900 mm nominal diameter plastic, Oriented PVC plastic filament-wound or centrifugally cast reinforced thermosetting resin, reinforced plastic mortar pressure pipe, or reinforced concrete, unless otherwise shown or specified.

1.2.2 Sprinkler Supply Lines

Piping for water lines supplying sprinkler systems for building fire protection shall conform to NFPA 24 from the point of connection with the water distribution system to the building 1.5 m line.

1.2.3 Potable Water Lines

Piping and components of potable water systems which come in contact with the potable water shall conform to NSF 61.

1.2.4 Plastic Piping System

Plastic piping system components intended for transportation of potable water shall comply with NSF 14 and be legibly marked with their symbol.

1.2.5 Excavation, Trenching, and Backfilling

Excavation, trenching, and backfilling shall be in accordance with the applicable provisions of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation;.

The manufacturer's recommendations for each material or procedure to be utilized.

Waste Water Disposal Method; .

The method proposed for disposal of waste water from hydrostatic tests and disinfection, prior to performing hydrostatic tests.

Satisfactory Installation; .

A statement signed by the principal officer of the contracting firm stating that the installation is satisfactory and in accordance with the contract drawings and specifications, and the manufacturer's prescribed procedures and techniques, upon completion of the project and before final acceptance.

SD-06 Test Reports

Bacteriological Disinfection.

Test results from commercial laboratory verifying disinfection.

Meters; G.

Manufacturer's certificate stating that each meter furnished has been tested for accuracy of registration and compliance with the accuracy and capacity requirements of the appropriate AWWA standard.

1.4 HANDLING

Pipe and accessories shall be handled to ensure delivery to the trench in sound, undamaged condition, including no injury to the pipe coating or lining. If the coating or lining of any pipe or fitting is damaged, the repair shall be made by the Contractor in a satisfactory manner, at no additional cost to the Government. No other pipe or material shall be placed inside a pipe or fitting after the coating has been applied. Pipe shall be carried into position and not dragged. Use of pinch bars and tongs for aligning or turning pipe will be permitted only on the bare ends of the pipe. The interior of pipe and accessories shall be thoroughly cleaned of foreign matter before being lowered into the trench and shall be kept clean during laying operations by plugging or other approved method. Before installation, the pipe shall be inspected for defects. Material found to be defective before or after laying shall be replaced with sound material without additional expense to the Government. Rubber gaskets that are not to be installed immediately shall be stored in a cool and dark place.

1.4.1 Miscellaneous Plastic Pipe and Fittings

Polyvinyl Chloride (PVC) pipe and fittings shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

2.1.1.1 PE Plastic Pipe

Pipe, tubing, and heat-fusion fittings shall conform to AWWA C901.

2.1.1.2 PVC Plastic Pipe

Pipe, couplings and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454B.

- a. Pipe 100 through 300 mm Diameter: Pipe, couplings and fittings shall conform to AWWA C900, Class 150, CIOD pipe dimensions, elastomeric-gasket joint, unless otherwise shown or specified.
- b. Pipe 350 through 900 mm Diameter: Pipe shall conform to AWWA C905 unless otherwise shown or specified.

2.1.1.3 Oriented Polyvinyl Chloride (PVCO) Plastic Pipe

Pipe, couplings, and fittings shall be manufactured of material conforming to ASTM D 1784, Class 12454-B. Pipe shall conform to AWWA C909, Class 150, and to ASTM F 1483 and shall have an outside diameter equal to cast iron outside diameter.

2.2 FITTINGS AND SPECIALS

2.2.1 PVC Pipe System

For pipe 100 mm diameter and larger, fittings and specials shall be iron, bell end in accordance with AWWA C110, 1.03 MPa pressure rating unless otherwise shown or specified, except that profile of bell may have special dimensions as required by the pipe manufacturer; or fittings and specials may be of the same material as the pipe with elastomeric gaskets, all in conformance with AWWA C900. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104. Fittings shall be bell and spigot or plain end pipe, or as applicable. Ductile iron compact fittings shall be in accordance with AWWA C153.

2.3 JOINTS

2.3.1 Plastic Pipe Jointing

2.3.1.1 PE Pipe

Joints for pipe fittings and couplings shall be strong tight joints as specified for PE in Paragraph INSTALLATION. Joints connecting pipe of differing materials shall be made in

accordance with the manufacturer's recommendation, and as approved by the Contracting Officer.

2.3.1.2 PVC Pipe

Joints, fittings, and couplings shall be as specified for PVC pipe. Joints connecting pipe of differing materials shall be made in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer.

2.3.1.3 PVCO Pipe

Joints shall conform to ASTM D 3139. Elastomeric gaskets shall conform to ASTM F 477.

2.4 VALVES

2.4.1 Gate Valves

Gate valves shall be designed for a working pressure of not less than 1.03 MPa. Valve connections shall be as required for the piping in which they are installed. Valves shall have a clear waterway equal to the full nominal diameter of the valve, and shall be opened by turning counterclockwise. The operating nut or wheel shall have an arrow, cast in the metal, indicating the direction of opening.

Valves 80 mm and larger shall be iron body, bronze mounted, and shall conform to AWWA C500. Flanges shall not be buried. An approved pit shall be provided for all flanged connections.

2.4.3 Indicator Post for Valves

Each valve shown on the drawings with the designation "P.I.V." shall be equipped with indicator post conforming to the requirements of NFPA 24. Operation shall be by a wrench which shall be attached to each post.

2.5 VALVE BOXES

Valve boxes shall be cast iron or concrete, except that concrete boxes may be installed only in locations not subjected to vehicular traffic. Cast-iron boxes shall be extension type with slide-type adjustment and with flared base. The minimum thickness of metal shall be 5 mm. Concrete boxes shall be the standard product of a manufacturer of precast concrete equipment. The word "WATER" shall be cast in the cover. The box length shall adapt, without full extension, to the depth of cover required over the pipe at the valve location.

2.7 FIRE HYDRANTS

Hydrants shall be dry-barrel type conforming to AWWA C502 with valve opening at least 125 mm in diameter and designed so that the flange at the main valve seat can be removed with the main valve seat apparatus remaining intact, closed and reasonably tight against leakage and with a breakable valve rod coupling and breakable flange connections located no more than 200 mm above the ground grade. Hydrants shall have a 150 mm bell connection, two 65 mm hose connections and one 115 mm pumper connection. Outlets shall have American National Standard fire-hose coupling threads. Working parts shall be bronze. Design,

material, and workmanship shall be equal to the latest stock pattern ordinarily produced by the manufacturer. Hydrants shall be painted with 1 coat of red iron oxide, zinc oxide primer conforming to SSPC Paint 25 and 2 finish coats of silicone alkyd paint conforming to SSPC Paint 21, of the installation's standard colors or as directed by the Contracting Officer. Suitable bronze adapter for each outlet, with caps, shall be furnished.

2.8 MISCELLANEOUS ITEMS

2.8.1 Service Clamps

Service clamps shall have a pressure rating not less than that of the pipe to be connected and shall be double flattened strap type. Clamps shall have a galvanized malleable-iron body with cadmium plated straps and nuts. Clamps shall have a rubber gasket cemented to the body.

2.8.2 Corporation Stops

Corporation stops shall have standard corporation stop thread conforming to AWWA C800 on the inlet end, with flanged joints, compression pattern flared tube couplings, or wiped joints for connections to goosenecks.

2.8.3 Goosenecks

Copper tubing for gooseneck connections shall conform to the applicable requirements of ASTM B 88M ASTM B 88, Type K, annealed. Length of cable requirement connections shall be in accordance with standard practice.

2.8.4 Service Stops

Service stops shall be water-works inverted-ground-key type, oval or round flow way, tee handle, without drain. Pipe connections shall be suitable for the type of service pipe used. All parts shall be of bronze with female iron-pipe-size connections or compression-pattern flared tube couplings, and shall be designed for a hydrostatic test pressure not less than 1.375 MPa.

2.8.5 Tapping Sleeves

Tapping sleeves of the sizes indicated for connection to existing main shall be the cast gray, ductile, or malleable iron, split-sleeve type with flanged or grooved outlet, and with bolts, follower rings and gaskets on each end of the sleeve. Construction shall be suitable for a maximum working pressure of 1.03 MPa. Bolts shall have square heads and hexagonal nuts. Longitudinal gaskets and mechanical joints with gaskets shall be as recommended by the manufacturer of the sleeve. When using grooved mechanical tee, it shall consist of an upper housing with full locating collar for rigid positioning which engages a machine-cut hole in pipe, encasing an elastomeric gasket which conforms to the pipe outside diameter around the hole and a lower housing with positioning lugs, secured together during assembly by nuts and bolts as specified, pretorqued to 67.8 Newton meters.

2.8.6 Service Boxes

Service boxes shall be cast iron or concrete and shall be extension service boxes of the length required for the depth of the line, with either screw or slide-type adjustment. The boxes shall have housings of sufficient size to completely cover the service stop or valve and shall be complete with identifying covers.

2.8.7 Disinfection

Chlorinating materials shall conform to the following:

Chlorine, Liquid: AWWA B301.

Hypochlorite, Calcium and Sodium: AWWA B300.

2.8.8 Meters

Meters shall be the type and size shown on the drawings or specified. Meters of each of the various types furnished and installed shall be supplied by one manufacturer.

2.8.8.1 Displacement Type

Displacement type meters shall conform to AWWA C700. Registers shall be straight-reading and shall read in cubic meters. Meters in sizes 13 through 25 mm shall be frost-protection design. Connections shall be suitable to the type of pipe and conditions encountered. Register type shall be a direct reading remote register designed in accordance with AWWA.

2.8.9 Meter Boxes

Meter boxes shall be of cast iron or plastic. The boxes shall be of sufficient size to completely enclose the meter and shutoff valve or service stop. Meter boxes set in paved areas subject to vehicular traffic shall be cast iron, or concrete with cast iron lid and cast iron meter reader lid. Boxes set in sidewalks, not subject to vehicular traffic, shall use concrete covers with cast iron meter reader lids. Plastic boxes and lids shall not be used in unpaved areas or grass areas not subject to vehicular traffic. Box height shall extend from invert of the meter to final grade at the meter location. The lid shall have the word "WATER" cast in it.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Cutting of Pipe

Cutting of pipe shall be done in a neat and workmanlike manner without damage to the pipe. Unless otherwise recommended by the manufacturer and authorized by the Contracting Officer, cutting shall be done with an approved type mechanical cutter. Wheel cutter shall be used when practicable. Copper tubing shall be cut square and all burrs shall be removed. Squeeze type mechanical cutters shall not be used for ductile iron.

3.1.2 Adjacent Facilities

3.1.2.1 Sewer Lines

Where the location of the water pipe is not clearly defined in dimensions on the drawings, the water pipe shall not be laid closer horizontally than 3 m from a sewer except where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, in which case the water pipe shall not be laid closer horizontally than 1.8 m from the sewer. Where water lines cross under gravity-flow sewer lines, the sewer pipe, for a distance of at least 3 m each side of the crossing, shall be fully encased in concrete or shall be made of pressure pipe with no joint located within 900 mm horizontally of the crossing. Water lines shall in all cases cross above sewage force mains or inverted siphons and shall be not less than 600 mm above the sewer main. Joints in the sewer main, closer horizontally than 900 mm to the crossing, shall be encased in concrete.

3.1.2.2 Water Lines

Water lines shall not be laid in the same trench with sewer lines, gas lines, fuel lines, or electric wiring.

3.1.2.3 Copper Tubing Lines

Copper tubing shall not be installed in the same trench with ferrous piping materials.

3.1.2.4 Nonferrous Metallic Pipe

Where nonferrous metallic pipe, e.g. copper tubing, crosses any ferrous piping material, a minimum vertical separation of 300 mm shall be maintained between pipes.

3.1.2.5 Structures

Where water pipe is required to be installed within 1 m of existing structures, the water pipe shall be sleeved as required in Paragraph "Casing Pipe". The Contractor shall install the water pipe and sleeve ensuring that there will be no damage to the structures and no settlement or movement of foundations or footings.

3.1.3 Joint Deflection

3.1.3.1 Offset for Flexible Plastic Pipe

Maximum offset in alignment between adjacent pipe joints shall be as recommended by the manufacturer and approved by the Contracting Officer, but shall not exceed 5 degrees.

3.1.4 Placing and Laying

Pipe and accessories shall be carefully lowered into the trench by means of derrick, ropes, belt slings, or other authorized equipment. Water-line materials shall not be dropped or dumped into the trench. Abrasion of the pipe coating shall be avoided. Except where necessary in making connections with other lines or as authorized by the Contracting Officer, pipe shall be laid with the bells facing in the direction of laying. The full length of each section of pipe shall rest solidly upon the pipe bed, with recesses excavated to accommodate bells,

couplings, and joints. Pipe that has the grade or joint disturbed after laying shall be taken up and relaid. Pipe shall not be laid in water or when trench conditions are unsuitable for the work. Water shall be kept out of the trench until joints are complete. When work is not in progress, open ends of pipe, fittings, and valves shall be securely closed so that no trench water, earth, or other substance will enter the pipes or fittings. Where any part of the coating or lining is damaged, the repair shall be made by and at the Contractor's expense in a satisfactory manner. Pipe ends left for future connections shall be valved, plugged, or capped, and anchored, as shown.

3.1.4.1 Plastic Pipe Installation

RTRP shall be installed in accordance with ASTM D 3839. RPMP shall be installed in accordance with the manufacturer's recommendations. PE Pipe shall be installed in accordance with ASTM D 2774. PVC pipe shall be installed in accordance with AWWA M23.

3.1.4.2 Piping Connections

Where connections are made between new work and existing mains, the connections shall be made by using specials and fittings to suit the actual conditions. When made under pressure, these connections shall be installed using standard methods as approved by the Contracting Officer. Connections to existing asbestos-cement pipe shall be made in accordance with ACPPA Work Practices.

3.1.4.3 Penetrations

Pipe passing through walls of valve pits and structures shall be provided with ductile-iron or Schedule 40 steel wall sleeves. Annular space between walls and sleeves shall be filled with rich cement mortar. Annular space between pipe and sleeves shall be filled with mastic.

3.1.5 Jointing

3.1.5.1 PVC Plastic Pipe Requirements

- a. Pipe 100 through 300 mm diameter: Joints shall be elastomeric gasket as specified in AWWA C900. Jointing procedure shall be as specified for pipe less than 100 mm diameter with configuration using elastomeric ring gasket.
- b. Pipe 350 through 900 mm diameter: Joints shall be elastomeric gasket push-on joints made in accordance with AWWA M23.

3.1.6 Installation of Service Lines

Service lines shall include the pipeline connecting building piping to water distribution lines to the connections with the building service at a point approximately 1.5 m outside the building where such building service exists. Where building services are not installed, the Contractor shall terminate the service lines approximately 1.5 m from the site of the proposed building at a point designated by the Contracting Officer. Such service lines shall be closed with plugs or caps. All service stops and valves shall be provided with service boxes. Service lines shall be constructed in accordance with the following requirements:

3.1.6.1 Service Lines Larger than 50 mm

Service lines larger than 50 mm shall be connected to the main by a tapped saddle, tapping sleeve and valve, service clamp or reducing tee, depending on the main diameter and the service line diameter, and shall have a gate valve.

3.1.6.2 Service Lines for Sprinkler Supplies

Water service lines used to supply building sprinkler systems for fire protection shall be connected to the water distribution main in accordance with NFPA 24.

3.1.7 Setting of Meters, Valves and Valve Boxes

3.1.7.1 Location of Fire Hydrants

Fire hydrants shall be located and installed as shown. Each hydrant shall be connected to the main with a 150 mm branch line having at least as much cover as the distribution main. Hydrants shall be set plumb with pumper nozzle facing the roadway, with the center of the lowest outlet not less than 450 mm above the finished surrounding grade, and the operating nut not more than 1.2 m above the finished surrounding grade. Fire hydrants designated on the drawings as low profile shall have the lowest outlet not less than 450 mm above the finished surrounding grade, the top of the hydrant not more than 600 mm above the finished surrounding grade. Except where approved otherwise, the backfill around hydrants shall be thoroughly compacted to the finished grade immediately after installation to obtain beneficial use of the hydrant as soon as practicable. The hydrant shall be set upon a slab of concrete not less than 100 mm thick and 400 mm square. Not less than 2 cubic meters of free-draining broken stone or gravel shall be placed around and beneath the waste opening of dry barrel hydrants to ensure drainage.

3.1.7.2 Location of Valves

After delivery, valves, including those in hydrants, shall be drained to prevent freezing and shall have the interiors cleaned of all foreign matter before installation. Stuffing boxes shall be tightened and hydrants and valves shall be fully opened and fully closed to ensure that all parts are in working condition. Check, pressure reducing, vacuum, and air relief valves shall be installed in valve pits. Valves and valve boxes shall be installed where shown or specified, and shall be set plumb. Valve boxes shall be centered on the valves. Boxes shall be installed over each outside gate valve unless otherwise shown. Where feasible, valves shall be located outside the area of roads and streets. Earth fill shall be tamped around each valve box or pit to a distance of 1.2 m on all sides of the box, or the undisturbed trench face if less than 1.2 m.

3.1.7.3 Location of Service Boxes

Where water lines are located below paved streets having curbs, the boxes shall be installed directly back of the curbs. Where no curbing exists, service boxes shall be installed in accessible locations, beyond the limits of street surfacing, walks and driveways.

3.1.8 Tapped Tees and Crosses

Tapped tees and crosses for future connections shall be installed where shown.

3.1.9 Thrust Restraint

Plugs, caps, tees and bends deflecting 11.25 degrees or more, either vertically or horizontally, on waterlines 100 mm in diameter or larger, and fire hydrants shall be provided with thrust restraints. Valves shall be securely anchored or shall be provided with thrust restraints to prevent movement. Thrust restraints shall be either thrust blocks or, for ductile-iron pipes, restrained joints.

3.1.9.1 Thrust Blocks

Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa after 28 days. Blocking shall be placed between solid ground and the hydrant or fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of thrust blocks shall be poured directly against undisturbed earth. The sides of thrust blocks not subject to thrust may be poured against forms. The area of bearing shall be as shown or as directed. Blocking shall be placed so that the fitting joints will be accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.2 HYDROSTATIC TESTS

Where any section of a water line is provided with concrete thrust blocking for fittings or hydrants, the hydrostatic tests shall not be made until at least 5 days after installation of the concrete thrust blocking, unless otherwise approved.

3.2.1 Pressure Test

After the pipe is laid, the joints completed, fire hydrants permanently installed, and the trench partially backfilled leaving the joints exposed for examination, the newly laid piping or any valved section of piping shall, unless otherwise specified, be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Water supply lines designated on the drawings shall be subjected for 1 hour to a hydrostatic pressure test of 1.38 MPa. Each valve shall be opened and closed several times during the test. Exposed pipe, joints, fittings, hydrants, and valves shall be carefully examined during the partially open trench test. Joints showing visible leakage shall be replaced or remade as necessary. Cracked or defective pipe, joints, fittings, hydrants and valves discovered in consequence of this pressure test shall be removed and replaced with sound material, and the test shall be repeated until the test results are satisfactory. The requirement for the joints to remain exposed for the hydrostatic tests may be waived by the Contracting Officer when one or more of the following conditions is encountered:

- a. Wet or unstable soil conditions in the trench.
- b. Compliance would require maintaining barricades and walkways around and across an open trench in a heavily used area that would require continuous surveillance to assure safe conditions.
- c. Maintaining the trench in an open condition would delay completion of the project.

The Contractor may request a waiver, setting forth in writing the reasons for the request and stating the alternative procedure proposed to comply with the required hydrostatic tests. Backfill placed prior to the tests shall be placed in accordance with the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2.2 Leakage Test

Leakage test shall be conducted after the pressure tests have been satisfactorily completed. The duration of each leakage test shall be at least 2 hours, and during the test the water line shall be subjected to not less than 1.38 MPa pressure. Water supply lines designated on the drawings shall be subjected to a pressure equal to 1.38 MPa. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved or approved section, necessary to maintain pressure within 34.5 kPa of the specified leakage test pressure after the pipe has been filled with water and the air expelled. Piping installation will not be accepted if leakage exceeds the allowable leakage which is determined by the following formula:

$$L = 0.0001351ND(P \text{ raised to } 0.5 \text{ power})$$

L = Allowable leakage in gallons per hour

N = Number of joints in the length of pipeline tested

D = Nominal diameter of the pipe in inches

P = Average test pressure during the leakage test, in psi gauge

Should any test of pipe disclose leakage greater than that calculated by the above formula, the defective joints shall be located and repaired until the leakage is within the specified allowance, without additional cost to the Government.

3.2.3 Time for Making Test

Except for joint material setting or where concrete thrust blocks necessitate a 5-day delay, pipelines jointed with rubber gaskets, mechanical or push-on joints, or couplings may be subjected to hydrostatic pressure, inspected, and tested for leakage at any time after partial completion of backfill. Cement-mortar lined pipe may be filled with water as recommended by the manufacturer before being subjected to the pressure test and subsequent leakage test.

3.2.4 Concurrent Hydrostatic Tests

The Contractor may elect to conduct the hydrostatic tests using either or both of the following procedures. Regardless of the sequence of tests employed, the results of pressure tests, leakage tests, and disinfection shall be as specified. Replacement, repair or retesting required shall be accomplished by the Contractor at no additional cost to the Government.

- a. Pressure test and leakage test may be conducted concurrently.
- b. Hydrostatic tests and disinfection may be conducted concurrently, using the water treated for disinfection to accomplish the hydrostatic tests. If water is lost when treated for disinfection and air is admitted to the unit being tested, or if any repair procedure results in contamination of the unit, disinfection shall be reaccomplished.

3.3 BACTERIAL DISINFECTION

3.3.1 Bacteriological Disinfection

Before acceptance of potable water operation, each unit of completed waterline shall be disinfected as specified. After pressure tests have been made, the unit to be disinfected shall be thoroughly flushed with water until all entrained dirt and mud have been removed before introducing the chlorinating material. The chlorinating material shall be either liquid chlorine, calcium hypochlorite, or sodium hypochlorite, conforming to paragraph MISCELLANEOUS ITEMS. The chlorinating material shall provide a dosage of not less than 50 ppm and shall be introduced into the water lines in an approved manner. Polyvinyl Chloride (PVC) pipe lines shall be chlorinated using only the above specified chlorinating material in solution. The agent shall not be introduced into the line in a dry solid state. The treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. Except where a shorter period is approved, the retention time shall be at least 24 hours and shall produce not less than 25 ppm of free chlorine residual throughout the line at the end of the retention period. Valves on the lines being disinfected shall be opened and closed several times during the contact period. The line shall then be flushed with clean water until the residual chlorine is reduced to less than 1.0 ppm. During the flushing period, each fire hydrant on the line shall be opened and closed several times. From several points in the unit, the Contracting Officer will take samples of water in proper sterilized containers for bacterial examination. The disinfection shall be repeated until tests indicate the absence of pollution for at least 2 full days. The unit will not be accepted until satisfactory bacteriological results have been obtained.

3.4 CLEANUP

Upon completion of the installation of water lines, and appurtenances, all debris and surplus materials resulting from the work shall be removed.

END OF SECTION

SECTION 02531
SANITARY SEWERS

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM C 150	(1999a) Portland Cement
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2680	(1995a) Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Composite Sewer Piping
ASTM D 2751	(1996a) Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM F 402	(1993; R 1999) Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 949	(2000) Poly(Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 704	(1996) Identification of the Fire Hazards of Materials for Emergency Response
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UNI-BELL PVC PIPE ASSOCIATION (UBPPA)

UBPPA UNI-B-6	(1990) Recommended Practice for the Low-Pressure Air Testing of Installed Sewer Pipe
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UBPPA UNI-B-9

(1990; Addenda 1994) Recommended Performance Specification for Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4-48 inch)

1.2 GENERAL REQUIREMENTS

The construction required herein shall include appurtenant structures and building sewers to points of connection with the building drains 1.5 m outside the building to which the sewer system is to be connected. The Contractor shall replace damaged material and redo unacceptable work at no additional cost to the Government. Excavation and backfilling is specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Backfilling shall be accomplished after inspection by the Contracting Officer. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install the plastic pipe shall be stored in accordance with the manufacturer's recommendation and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Portland Cement; _____

Certificates of compliance stating the type of cement used in manufacture of concrete pipe, fittings and precast manholes.

Joints; _____

PART 2 PRODUCTS

2.1 PIPE

Pipe shall conform to the respective specifications and other requirements specified below.

2.1.1 Plastic Pipe

Acrylonitrile-butadiene-styrene (ABS) and polyvinyl chloride (PVC) composite sewer piping shall conform to ASTM D 2680. Size 200 mm through 380 mm diameter.

2.1.1.1 ABS Pipe

ASTM D 2751.

2.1.1.2 PVC Pipe

ASTM D 3034, Type PSM with a maximum SDR of 35, Size 380 mm or less in diameter. ASTM F 949 for corrugated sewer pipes with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior, size 200 mm through 1200 mm diameters. PVC shall be certified by the compounder as meeting the requirements of ASTM D 1784, cell Class 12454B. The pipe stiffness shall be greater than or equal to 735/D for cohesionless material pipe trench backfills.

2.2 REQUIREMENTS FOR FITTINGS

Fittings shall be compatible with the pipe supplied and shall have a strength not less than that of the pipe. Fittings shall conform to the respective specifications and other requirements specified below.

2.2.1 Fittings for Plastic Pipe

ABS and PVC composite sewer pipe fittings shall conform to ASTM D 2680.

2.2.1.1 Fittings for ABS Pipe

ASTM D 2751.

2.2.1.2 Fittings for PVC Pipe

ASTM D 3034 for type PSM pipe. ASTM F 949 for corrugated sewer pipe with a smooth interior. UBPPA UNI-B-9 and ASTM F 794, Series 46, for ribbed sewer pipe with smooth interior.

2.3 JOINTS

Joints installation shall comply with the manufacturer's instructions.

2.3.1 Plastic Pipe Jointing

Flexible plastic pipe (PVC pipe) gasketed joints shall conform to ASTM D 3212.

2.3.1.1 ABS Pipe Jointing

ASTM D 2751, solvent weld or bell and spigot O-ring joint, size 300 mm or less in diameter, dimensions and tolerances in accordance with Table 2 of ASTM D 2751.

2.4 BRANCH CONNECTIONS

Branch connections shall be made by use of regular fittings or solvent cemented saddles as approved. Saddles for ABS and PVC composite pipe shall conform to Figure 2 of ASTM D

2680; saddles for ABS pipe shall comply with Table 3 of ASTM D 2751; and saddles for PVC pipe shall conform to Table 4 of ASTM D 3034.

2.5 FRAMES AND COVERS

Frames and covers shall be cast iron, ductile iron or reinforced concrete. Cast iron frames and covers shall be as indicated or shall be of type suitable for the application, circular, without vent holes. The frames and covers shall have a combined weight of not less than 181.4 kg. Reinforced concrete frames and covers shall be as indicated or shall conform to ASTM C 478 or ASTM C 478M. The word "Sewer" shall be stamped or cast into covers so that it is plainly visible.

2.6 STEEL LADDER

A steel ladder shall be provided where the depth of a manhole exceeds 3.6 m . The ladder shall not be less than 406 mm in width, with 19 mm diameter rungs spaced 305 mm apart. The two stringers shall be a minimum 10 mm thick and 51 mm wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.7 CEMENT MORTAR

Cement mortar shall conform to ASTM C 270, Type M with Type II cement.

2.7.1 Portland Cement

Portland cement shall conform to ASTM C 150, Type II for concrete used in concrete pipe, concrete pipe fittings, and manholes and type optional with the Contractor for cement used in concrete cradle, concrete encasement, and thrust blocking.

2.7.2 Portland Cement Concrete

Portland cement concrete shall conform to ASTM C 94/C 94M, compressive strength of 28 MPa 4000 psi at 28 days, except for concrete cradle and encasement or concrete blocks for manholes. Concrete used for cradle and encasement shall have a compressive strength of 17 MPa minimum at 28 days. Concrete in place shall be protected from freezing and moisture loss for 7 days.

2.8 STRUCTURES

2.8.1 Precast Reinforced Concrete Manhole Sections

Precast reinforced concrete manhole sections shall conform to ASTM C 478, except that portland cement shall be as specified herein. Joints shall be cement mortar, an approved mastic, rubber gaskets, a combination of these types; or the use of external preformed rubber joint seals and extruded rolls of rubber with mastic adhesive on one side.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Adjacent Facilities

3.1.1.1 Water Lines

Where the location of the sewer is not clearly defined by dimensions on the drawings, the sewer shall not be closer horizontally than 3 m 10 feet to a water-supply main or service line, except that where the bottom of the water pipe will be at least 300 mm above the top of the sewer pipe, the horizontal spacing may be a minimum of 2 m. Where gravity-flow sewers cross above water lines, the sewer pipe for a distance of 3 m on each side of the crossing shall be fully encased in concrete or shall be acceptable pressure pipe with no joint closer horizontally than 1 m to the crossing. The thickness of the concrete encasement including that at the pipe joints shall be not less than 100 mm.

3.1.1.2 Structural Foundations

Where sewer pipe is to be installed within 1 m of an existing or proposed building or structural foundation such as a retaining wall, control tower footing, water tank footing, or any similar structure, the sewer pipe shall be sleeved as specified above. Contractor shall ensure there is no damage to these structures, and no settlement or movement of foundations or footing.

3.1.2 Pipe Laying

- a. Pipe shall be protected during handling against impact shocks and free fall; the pipe interior shall be free of extraneous material.
- b. Pipe laying shall proceed upgrade with the spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow. Each pipe shall be laid accurately to the line and grade shown on the drawings. Pipe shall be laid and centered so that the sewer has a uniform invert. As the work progresses, the interior of the sewer shall be cleared of all superfluous materials.
- c. Before making pipe joints, all surfaces of the portions of the pipe to be joined shall be clean and dry. Lubricants, primers, and adhesives shall be used as recommended by the pipe manufacturer. The joints shall then be placed, fitted, joined, and adjusted to obtain the degree of water tightness required.
- d. ABS composite pipe ends with exposed truss and filler material shall be coated with solvent weld material before making the joint to prevent water or air passage at the joint between the inner and outer wall of the pipe.
- e. Installations of solvent weld joint pipe, using ABS or PVC pipe and fittings shall be in accordance with ASTM F 402. The Contractor shall ensure adequate trench ventilation and protection for workers installing the pipe.

3.1.2.1 Trenches

Trenches shall be kept free of water and as dry as possible during bedding, laying, and jointing and for as long a period as required. When work is not in progress, open ends of pipe and fittings shall be satisfactorily closed so that no trench water or other material will enter the pipe or fittings.

3.1.2.2 Backfill

As soon as possible after the joint is made, sufficient backfill material shall be placed along the pipe to prevent pipe movement off line or grade. Plastic pipe shall be completely covered to prevent damage from ultraviolet light.

3.1.2.3 Width of Trench

If the maximum width of the trench at the top of the pipe, as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, is exceeded for any reason other than by direction, the Contractor shall install, at no additional cost to the Government, concrete cradling, pipe encasement, or other bedding required to support the added load of the backfill.

3.1.2.4 Jointing

Joints between different pipe materials shall be made as specified, using approved jointing materials.

3.1.2.5 Handling and Storage

Pipe, fittings and joint material shall be handled and stored in accordance with the manufacturer's recommendations. Storage facilities for plastic pipe, fittings, joint materials and solvents shall be classified and marked in accordance with NFPA 704, with classification as indicated in NFPA 49 and NFPA 325-1.

3.1.3 Leakage Tests

Lines shall be tested for leakage by low pressure air testing, infiltration tests or exfiltration tests, as appropriate. Low pressure air testing for vitrified clay pipes shall be as prescribed in ASTM C 828. Low pressure air testing for concrete pipes shall be as prescribed in ASTM C 828. Low pressure air testing for PVC pipe shall be as prescribed in UBPPA UNI-B-6. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 and ASTM C 924M ASTM C 924, after consultation with the pipe manufacturer. Prior to infiltration or exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. When the Contracting Officer determines that infiltration cannot be properly tested, an exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be

allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be re-established. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by either the infiltration test or exfiltration test shall not exceed 94 L per 1 mm diameter per km of pipeline per day . When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correction, and retesting shall be made at no additional cost to the Government.

3.1.4 Test for Deflection

When flexible pipe is used, a deflection test shall be made on the entire length of the installed pipeline not less than 30 days after the completion of all work including the leakage test, backfill, and placement of any fill, grading, paving, concrete, or superimposed loads. Deflection shall be determined by use of a deflection device or by use of a spherical, spheroidal, or elliptical ball, a cylinder, or circular sections fused to a common shaft. The ball, cylinder, or circular sections shall have a diameter, or minor diameter as applicable, of 92.5 percent of the inside diameter of the pipe, but 95 percent for RPMP and RTRP. A tolerance of plus 0.5 percent will be permitted. The ball, cylinder, or circular sections shall be of a homogeneous material throughout, shall have a density greater than 1.0 as related to water at 4.0 degrees C , and shall have a surface brinell hardness of not less than 150. The device shall be center bored and through bolted with a 6 mm minimum diameter steel shaft having a yield strength of 480 MPa or more, with eyes at each end for attaching pulling cables. The eye shall be suitably backed with flange or heavy washer; a pull exerted on the opposite end of the shaft shall produce compression throughout the remote end of the ball, cylinder or circular section. Circular sections shall be spaced so that the distance from the external faces of the front and back sections shall equal or exceed the diameter of the circular section. Failure of the ball, cylinder, or circular section to pass freely through a pipe run, either by being pulled through or by being flushed through with water, shall be cause for rejection of that run. When a deflection device is used for the test in lieu of the ball, cylinder, or circular sections described, such device shall be approved prior to use. The device shall be sensitive to 1.0 percent of the diameter of the pipe being measured and shall be accurate to 1.0 percent of the indicated dimension. Installed pipe showing deflections greater than 7.5 percent of the normal diameter of the pipe, or 5 percent for RTRP and RPMP, shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.2 CONCRETE CRADLE AND ENCASEMENT

The pipe shall be supported on a concrete cradle, or encased in concrete where indicated or directed.

3.3 INSTALLATION OF WYE BRANCHES

Wye branches shall be installed where sewer connections are indicated or where directed. Cutting into piping for connections shall not be done except in special approved cases. When the connecting pipe cannot be adequately supported on undisturbed earth or tamped backfill, the pipe shall be encased in concrete backfill or supported on a concrete cradle as directed. Concrete required because of conditions resulting from faulty construction methods or negligence by the Contractor shall be installed at no additional cost to the Government. The installation of wye branches in an existing sewer shall be made by a method which does not damage the integrity of the existing sewer. One acceptable method consists of removing one

pipe section, breaking off the upper half of the bell of the next lower section and half of the running bell of wye section. After placing the new section, it shall be rotated so that the broken half of the bell will be at the bottom. The two joints shall then be made with joint packing and cement mortar.

3.4 MANHOLE DETAILS

3.4.1 General Requirements

Manholes shall be constructed of concrete, or precast concrete manhole sections. The invert channels shall be smooth and semicircular in shape conforming to the inside of the adjacent sewer section. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. The invert channels shall be formed directly in the concrete of the manhole base, or shall be built up with brick and mortar, or shall be half tile laid in concrete, or shall be constructed by laying full section sewer pipe through the manhole and breaking out the top half after the surrounding concrete has hardened. Pipe connections shall be made to manhole using water stops, standard O-ring joints, special manhole coupling, or shall be made in accordance with the manufacturer's recommendation. The Contractor's proposed method of connection, list of materials selected, and specials required, shall be approved prior to installation. The floor of the manhole outside the channels shall be smooth and shall slope toward the channels not less than 100 mm per meter nor more than 200 mm per meter. Free drop inside the manholes shall not exceed 500 mm, 18 inches, measured from the invert of the inlet pipe to the top of the floor of the manhole outside the channels; drop manholes shall be constructed whenever the free drop would otherwise be greater than 500 mm. .

3.4.2 Steel Ladder Anchorage

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1850 mm apart vertically, and shall be installed to provide at least 150 mm of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.4.3 Jointing, Plastering and Sealing

Mortar joints shall be completely filled and shall be smooth and free from surplus mortar on the inside of the manhole. Mortar and mastic joints between precast rings shall be full-bedded in jointing compound and shall be smoothed to a uniform surface on both the interior and exterior of the manhole. Installation of rubber gasket joints between precast rings shall be in accordance with the recommendations of the manufacturer. Precast rings may also be sealed by the use of extruded rolls of rubber with mastic adhesive on one side.

3.4.4 Setting of Frames and Covers

Unless otherwise indicated, tops of frames and covers shall be set flush with finished grade in paved areas or 50 mm higher than finished grade in unpaved areas. Frame and cover assemblies shall be sealed to manhole sections using external preformed rubber joint seals that meet the requirements of ASTM D 412 and ASTM D 624, or other methods specified in paragraph Jointing, Plastering and Sealing, unless otherwise specified.

3.4.5 External Preformed Rubber Joint Seals

External preformed rubber joint seals and extruded rolls of rubber with mastic adhesive shall meet the requirements of ASTM D 412 and ASTM C 972 to ensure conformance with paragraph Leakage Tests. The seal shall be multi-section with neoprene rubber top section and all lower sections made of Ethylene Propylene Di Monomer (EPDM) rubber with a minimum thickness of 1.5 mm. Each unit shall consist of a top and a bottom section and shall have mastic on the bottom of the bottom section and mastic on the top and bottom of the top section. The mastic shall be non-hardening butyl rubber sealant and shall seal to the cone/top slab of the manhole/catch basin and over the lip of the casting. One unit shall seal a casting and up to six, 50 mm adjusting rings. The bottom section shall be 305 mm in height. A 152 mm high top section will cover up to two, 50 mm adjusting rings. A 305 mm high bottom section will cover up to six, 50 mm adjusting rings. Extension sections shall cover up to two more adjusting rings. Each extension shall overlap the bottom section by 50 mm and shall be overlapped by the top section by 50 mm.

3.5 CONNECTING TO EXISTING MANHOLES

Pipe connections to existing manholes shall be made so that finish work will conform as nearly as practicable to the applicable requirements specified for new manholes, including all necessary concrete work, cutting, and shaping. The connection shall be centered on the manhole. Holes for the new pipe shall be of sufficient diameter to allow packing cement mortar around the entire periphery of the pipe but no larger than 1.5 times the diameter of the pipe. Cutting the manhole shall be done in a manner that will cause the least damage to the walls.

3.6 BUILDING CONNECTIONS

Building connections shall include the lines to and connection with the building waste drainage piping at a point approximately 1.5 m outside the building, unless otherwise indicated. Where building drain piping is not installed, the Contractor shall terminate the building connections approximately 1.5 m from the site of the building at a point and in a manner designated.

3.7 CLEANOUTS AND OTHER APPURTENANCES

Cleanouts and other appurtenances shall be installed where shown on the drawings or as directed by the Contracting Officer, and shall conform to the detail of the drawings.

END OF SECTION

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SECTION 02555

PREFABRICATED UNDERGROUND HEATING DISTRIBUTION SYSTEM

PART 1 GENERAL

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1998) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications
ASTM A 106	(1997a) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 234/A 234M	(1997) Piping Fittings of Wrought Carbon Steel for Moderate and High Temperature Service
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM C 518	(1991) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
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1.2 SYSTEM DESCRIPTION

The system consists of a buried prefabricated low temperature hot water distribution system including service connections to a point 150 mm (6 inches) inside of the building. The contract drawings show the specific arrangement of piping, sizes and grades of pipe, and other details. The system shall be designed for an operating pressure of 1135 kPa (150 psi) and an operating temperature of 120 degrees C (250 degrees F) for hot water.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Distribution System; G

Detail drawings consisting of fabrication and assembly drawings, for all parts of the work in sufficient detail to check conformity with the requirements of the contract documents, prior to installation. Detail drawings shall also contain complete piping, wiring and schematic diagrams and any other details to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout, method of compensation for pipe expansion and contraction, anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances required for maintenance and operation. The drawings shall clearly identify any proposed deviations from the requirements of the contract documents.

SD-03 Product Data

Distribution System;

Data composed of catalog cuts, brochures, circulars, specifications and product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

SD-07 Certificates

Distribution System;

The manufacturer's or system fabricator's written certification stating that the distribution system furnished meets all the requirements of this specification.

Welding;

Prior to welding operations, a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-10 Operation and Maintenance Data

Distribution System; G,

Six copies of operation and six copies of maintenance manuals for the equipment furnished, 1 complete set prior to performance testing and the remainder upon acceptance. Operation manuals shall detail the step-by-step procedures required for equipment startup, operation, and shutdown. Operation manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Maintenance manuals shall list routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Maintenance manuals shall include piping and equipment layout and simplified wiring and control diagrams of the equipment system as installed. Manuals shall be approved prior to the field performance testing.

1.4 DELIVERY AND STORAGE

After delivery to the jobsite, all materials and equipment shall be protected from anything which could cause damage to the material or equipment. Pipe shall be sealed at each end to keep the interior clean and free of dirt and debris. Fittings shall be kept together and their interior surfaces shall remain clean. Insulation shall be kept dry and clean.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 WELDING

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

System components shall be standard products of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The system shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.2 PIPING AND CASING MATERIALS

2.2.1 General

Metallic pressure pipe, fittings, and piping accessories shall conform to the requirements of ASME B31.1 and shall be types suitable for the temperature and pressure of the water.

2.2.2 Piping

2.2.2.1 Steel Pipe

Piping shall conform to ASTM A 53, Grade B, standard weight, black or to ASTM A 106, Grade B, standard weight.

2.2.2.2 Copper Tubing

Copper tubing shall conform to ASTM B 88, Type K or L.

2.2.3 Casings

2.2.3.1 Polyvinyl Chloride (PVC) Casing

PVC casings shall conform to ASTM D 1784, Class 12454-B with a minimum thickness equal to the greater of 1/100 the diameter of the casing or 1.50 mm (60 mils).

2.2.3.2 Polyethylene (PE) Casing

Polyethylene casings shall conform to ASTM D 1248, Type III, Class C, Category 3 or 4, Grade P 34 with thickness as follows:

Casing Diameter (in mm)	Minimum Thickness (in mm)
250 and smaller	3
250 to 450	4
450 to 600	5
over 600	6
Casing Diameter (in inches)	Minimum Thickness (in mils)
10 and smaller	125
10 to 18	150
18 through 24	200
over 24	225

2.3 PIPING CONNECTIONS

2.3.1 Steel Pipe

Steel pipe smaller than 20 mm (3/4 inch) may be threaded; otherwise, all steel pipe shall be welded. Steel welding fittings shall conform to the requirements of ASTM A 105/A 105M or ASTM A 234/A 234M. Welding fittings shall also conform to ASME B16.9 for butt-weld fittings and ASME B16.11 for socket-weld fittings. Long radius butt-welding elbows conforming to ASME B16.9 shall be used whenever space permits. Pipe Threads shall conform to ASME B1.20.1. Pipe to be threaded shall be schedule 80.

2.3.2 Copper Pipe

Copper pipe shall be brazed or connected using an insulated pipe coupling. Wrought copper or cast copper alloy solder joint pressure fittings shall conform to MSS SP-73. Insulated pipe couplings for copper pipe shall be cast bronze containing an O-ring seal on each end and shall be jacketed and sealed to act as an expansion joint.

2.4 END SEALS

2.4.1 General

Each preinsulated section of piping shall have a complete sealing of the insulation to provide a permanent water and vapor seal at each end of the preinsulated section of piping. Preinsulated sections of piping modified in the field shall be provided with an end seal which is equivalent to the end seals furnished with the preinsulated section of piping. End seals must be tested and certified in accordance with paragraph Casing and End Seal Testing and Certification.

2.4.2 Types

End seals provided shall be one of the following types:

- a. Carrying the outer casing over tapered pipe insulation ends and extending it to the carrier pipe. Sufficient surface bonding area shall be provided between the casing and the carrier pipe.
- b. Using specially designed molded caps made of polyethylene or rubber of standard manufactured thickness. A minimum 40 mm 1-1/2 inch surface bonding area shall be provided between the cap and both the casing and carrier pipe.
- c. Using elastomer-ring end seals designed and dimensioned to fit in the annular space between the casing and the carrier pipe.
- d. Using a waterproof mastic seal vapor barrier over the exposed insulation ends.
- e. Shrink sleeves.

2.4.3 Casing and End Seal Testing and Certification

Testing and certification procedures by an independent testing laboratory shall demonstrate that casings and end seals are capable of resisting penetration of water into the casing and insulation. The test shall be performed on the type of prefabricated system to be furnished. If more than one type of prefabricated system is to be used, then the tests shall be performed on each type. The test shall consist of hot and cold cycle testing followed by immersion in a water filled chamber with a head pressure. The hot and cold cycle testing shall consist of 14 days of temperature cycling. A fluid with a temperature of 5 degrees C (40 degrees F) shall circulate through the carrier pipe alternating every 24-hours with a fluid with a temperature of 95 degrees C (200 degrees F) circulating through the carrier pipe for a low temperature hot water or dual temperature service or 24 degrees (75 degrees F) for a chilled water service. While the hot and cold cycle test is being performed, the test sample is either buried or encased in dry bedding sand with a minimum of 300 mm (12 inches) of sand all around the test sample. The carrier pipe size of the test sample shall be 80 mm (3 inches) 3 inches in diameter and shall be restrained during the test period. The insulation thickness shall not exceed the maximum thickness provided for the piping in the project. Transition time for temperature cycle testing shall not exceed 15 minutes in going from cold to hot and 30 minutes in going from hot to cold. The fluid in the carrier pipe may be water, oil or heat transfer fluid. Following the hot and cold cycling test, the test sample shall be immersed in a water filled chamber. The pressure on the highest point of the test sample shall not be less than 60 kPa 20 feet of water head pressure subjected over the entire length of the 2.4 m 8 foot test sample of prefabricated pipe. The water shall contain a dye penetrant, which will be used to check for end seal leakage. The pressure in the chamber must be held for not less than 48 hours. Upon completion of this pressure test, the test sample shall be cut open. With the use of a light that will readily show the presence of the dye that was in the water, the test sample shall be inspected. Evidence of the dye inside the test sample shall indicate that the end seal is not acceptable and cannot be certified.

2.5 INSULATION

2.5.1 Factory Applied Insulation

Prefabricated pipe and fittings shall be insulated in the factory. Foam insulation for prefabricated insulated pipe and fittings shall be polyurethane foam meeting the requirements of ASTM C 591 having a density not less than 32 kg per cubic meter (2 pounds per cubic foot (pcf)). The polyurethane foam shall completely fill the annular space between the carrier pipe and the casing. Insulation thickness shall be a minimum of 20 mm (0.9 inches). The insulation thermal conductivity factor shall not exceed the numerical value of 0.02 W/mK (0.15 Btu-inch/square foot-degree F-hour) at 24 degrees C, 75 degrees F, when tested in accordance with ASTM C 518. Manufacturer shall certify that the insulated pipe is free of insulation voids.

2.5.2 Field Applied Insulation

Field applied insulation for fittings, and field casing closures, if required, and other piping system accessories shall be polyurethane matching the pipe insulation. Thickness shall match adjacent piping insulation thickness. Buried fittings and accessories shall have field applied polyurethane insulation to match adjacent piping and shall be protected with a covering matching the pipe casing. Shrink sleeves with a minimum thickness of 1.3 mm (50 mils) shall be provided over casing connection joints.

2.6 CONCRETE VALVE MANHOLES

Concrete valve manholes shall be provided.

2.7 PIPING AND EQUIPMENT IN VALVE MANHOLES

Piping and equipment in valve manholes shall be provided.

PART 3 EXECUTION

3.1 INSTALLATION

For all preinsulated, prefabricated systems, the Contractor shall obtain the services of a trained representative of the pipe system manufacturer to instruct the Contractor's work forces in the installation procedures to ensure that the system is installed in accordance with the manufacturer's published instructions and the plans and specifications. The manufacturer's representative shall be a person who regularly performs such duties for the manufacturer. The Contractor shall furnish the Contracting Officer a list of names of personnel trained and certified by the pipe system manufacturer in the installation of this system. Only personnel whose names appear on the list will be allowed to install the system. The list shall not be more than 1 year old.

3.2 PIPING SYSTEMS

3.2.1 Buried Insulated Systems

Buried insulated systems shall consist of carrier pipe, insulation, casing, end seals, fittings and accessories as specified.

3.3 VALVE MANHOLES AND PIPING EQUIPMENT IN VALVE MANHOLES

Valve manholes and piping and equipment in valve manholes shall be installed.

3.4 THRUST BLOCKS

Thrust blocks shall be installed at the locations shown or recommended by the pipe system manufacturer. Thrust blocks may not be required on all systems, and the need for thrust blocks shall be as recommended by the system manufacturer. Thrust blocks, if necessary, shall be installed at all changes in direction, changes in size, valves and terminal ends, such as plugs, caps and tees. Thrust blocks shall be concrete having a compressive strength of not less than 14 MPa (2000 psi) after 28 days and shall be in accordance with Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Thrust blocks shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and the thrust bearing sides of the thrust blocks shall be poured directly against undisturbed earth. The sides of the thrust blocks not subject to thrust may be poured against forms. Thrust blocks shall be placed so that the joints for all fittings will be accessible for repair wherever possible. No pipe joint shall be embedded in concrete unless the assembly has previously been hydrostatically tested. The thrust blocks shall provide for transfer of thrusts and reactions without exceeding the allowable stress of the concrete and shall be installed in accordance with pipe manufacturer's instructions. In muck or peat, all thrusts shall be

resisted by piles or tie rods to solid foundations or by removal of peat or muck which shall be replaced with ballast of sufficient stability to resist thrusts.

3.5 INSTALLATION OF PIPING SYSTEMS

The piping system furnished shall be installed in accordance with the piping system manufacturer's instructions. Piping shall be installed without springing or forcing other than what has been calculated for cold spring. Pipe ends shall have burrs removed by reaming and shall be installed to permit free expansion and contraction without damage to joints or hangers. Nonmetallic pipe cut in the field shall be machined to fit couplings or joints and shall be coated or treated to match standard factory coated ends. Copper tubing shall not be installed in the same trench with ferrous piping materials. When nonferrous metallic pipe (e.g., copper tubing) crosses any ferrous piping material, a minimum vertical separation of 300 mm 12 inches shall be maintained between pipes. Connections between different types of pipe and accessories shall be made with transition fittings approved by the manufacturer of the piping system.

3.5.1 Pitching of Horizontal Piping

Horizontal piping shall be pitched at a grade of not less than 40 mm in 1 m 1 inch in 20 feet toward the drain points unless otherwise indicated.

3.5.2 Open Ends

Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt and other foreign matter out of the system.

3.5.3 Cutting Prefabricated Piping Sections

Where prefabricated pipe sections are field cut, new end seals similar to the factory applied end seal shall be provided and installed in accordance with the manufacturer's instructions.

3.5.4 Joints

3.5.4.1 Welded Joints

Welded joints between sections of pipe and between pipe and fittings shall be provided where specified or indicated.

3.5.4.2 Threaded Joints

Threaded joints shall not be used belowground. Joints shall be made tight with polytetrafluoroethylene tape applied to the male threads only. Not more than 3 threads shall show after the joint is made up.

3.5.4.3 Brazed Joints

Brazed joints for copper pipe and fittings shall conform to CDA Tube Handbook. Brazing alloys melting above 593.3 degrees C (1100 degrees F) 1100 degrees F shall be utilized.

3.5.4.4 Nonmetallic Pipe Joints

Nonmetallic pipe joints shall be installed in accordance with the written instructions of the manufacturer.

3.5.5 Expansion Loops

If expansion compensation is needed, expansion loops and expansion bends (Z- and L- type) shall be factory fabricated of casing, insulation, and carrier piping identical to that furnished for straight runs. Expansion loops and bends shall be properly designed in accordance with the allowable stress limits indicated in ASME B31.1 for the type of pipe used. Expansion loops and bends shall be shipped to the jobsite in the maximum size sections feasible to minimize the number of field joints. The expansion loops and bends casing and insulation where applicable, shall be suitably sized to accommodate pipe movement. Field joints shall be made in straight runs of the expansion loops and bends, and the number shall be kept to a minimum. For steel pipe, cold springing shall not be allowed when sizing the expansion loops and bends, but piping shall be cold sprung one-half the calculated maximum operational expansion during field assembly. Pipe stress in expansion loops and bends shall conform to the requirements for expansion loops specified in ASME B31.1.

3.5.6 Anchors

Anchor design shall be in accordance with the published data of the manufacturer and for prefabricated systems shall be factory fabricated by the prefabricated system manufacturer. In all cases, the design shall be such that water penetration, condensation, or vapor transmission will not wet the insulation.

3.5.7 Field Casing Closures

Field insulation and encasement of joints shall be accomplished after the visual and pressure tests specified are completed. Field insulation and encasement shall be in accordance with the manufacturer's written instructions. Thickness dimensions of the insulation and casing materials shall not be less than those of the adjoining prefabricated section. Insulating material shall be foamed in place polyurethane. Care should be taken to ensure that field closures are made under conditions of temperature and cleanliness required to produce a sound, continuous vapor barrier. A standard polyethylene heat shrink sleeve shall be installed over the casing and shall have a 150 mm (6 inch) minimum overlap at each end.

3.5.8 Underground Warning Tape

Underground warning tape shall be buried above the piping during the trench backfilling and shall be buried approximately 300 mm (12 inches) deep. Tape shall be 0.1 mm (0.004 inch) thick polyethylene tape with metallic core. Tape shall be 150 mm (6 inches) wide and be printed with repetitive caution warnings along its length. Tapes shall be yellow in color with black letters. Tape color and lettering shall not be affected by moisture or other substances contained in the backfill material.

3.6 EARTHWORK

Earthwork shall be performed in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.8 TESTING

Tests shall be conducted before, during, and after installation of the system. All instruments, equipment, facilities, and labor required to properly conduct the tests shall be provided by the Contractor. Test pressure gauges for a specific test shall have dials indicating not less than 1-1/2 times nor more than 2 times the test pressure. It shall be the Contractor's responsibility to make the pipe system workable at his expense.

3.8.1 Metallic Pipe Welds

An approved independent testing firm or firms regularly engaged in radiographic testing shall perform a radiographic examination of the field welds. The radiographic testing shall be performed in accordance with ASME B31.1. All radiographs shall be reviewed and interpreted by a Certified Level III Radiographer employed by the testing firm. Any welds found to be unacceptable shall be removed, rewelded and radiographically reexamined in accordance with the above criteria. Such repair and reexamination shall be accomplished at no cost to the Government.

3.8.2 Carrier Pipe Cleaning and Testing

Distribution piping shall be tested as required before backfilling and with all joints exposed. The area between joints may be backfilled as necessary to prevent pipe movement.

3.8.2.1 Cleaning Carrier Pipe

Prior to testing, the interior of the carrier pipe shall be cleaned of foreign materials by thorough flushing with clean water. Water shall be circulated at a velocity between 2 and 3 m/s (7 and 10 feet per second) for a minimum of 4 hours. If required, temporary and/or supplementary pumps shall be provided to ensure that required velocity is achieved. System strainers shall be cleaned after the flushing operation is complete. Temporary strainers shall be installed as required. After flushing, the water shall remain in the piping system for testing of the system. All air shall be removed from the system prior to starting the tests.

3.8.2.2 Hydrostatic Pressure Cycling and Tests

Hydrostatic pressure cycling shall have 4 cycles. Each cycle shall consist of a 10 minute period at 1000 kPa (150 psig) followed by a 5 minute period at a pressure less than 350 kPa (50 psig). The next cycle shall begin immediately following the completion of the previous cycle. Pressure rise and drop shall not exceed 690 kPa (100 psi) per minute. The pressure gauge shall be located and the pressure measured at the opposite end of the system from where the pressure is applied. After completion of the hydrostatic pressure cycling, the first hydrostatic pressure test shall be performed. During the first hydrostatic pressure test, the system shall be proven tight at a pressure of 1-1/2 times the working pressure up to 1000 kPa (150 psig). This pressure shall be held for a minimum of 1 hour. The method of pressurizing the system shall be disconnected from the system before starting the 1 hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of pressure loss shall be determined, corrected and the hydrostatic pressure cycling and first hydrostatic pressure test shall be repeated until the system can hold the required pressure for at least 1 hour. After successful completion of the first hydrostatic pressure test, the water shall be drained out of the piping system and the piping system filled with treated water as defined in

paragraph TREATED WATER for the remaining tests and for permanent operation of the system. The hydrostatic pressure cycling and tests shall be repeated after the system has been filled with treated water, using the same test conditions and criteria.

3.8.2.3 Operational Test

Operational test shall be performed on the complete system or testable portions thereof. The test shall be conducted with full design flows and operating temperatures in all runs of piping as if in service, to demonstrate satisfactory function and operating effectiveness. The operational test will have two cycles. Each cycle shall consist of a 6-hour period with treated water in the system at the maximum operating temperature of 82 degrees C (180 degrees F) and maximum flow rate, and a period of at least 6-hours with no flow. The Contractor shall supply temporary pumps, piping connections, boilers, chillers and the gauges required to circulate the water at the desired temperatures and flow rates. Water shall be circulated through supply lines and returned through the return piping to demonstrate that the pressure drop is compatible with the flow rate and size of pipe and to show that obstructions do not exist in the piping system. Any unusual indicated pressure drop will be investigated and any obstructions removed. Any leaks found shall be repaired. After any obstructions have been removed and any leaks repaired, the operational test shall be repeated until successfully passed.

3.8.2.4 Final Hydrostatic Test

After successful completion of the operational test, the system shall be pressurized to 1-1/2 times the working pressure up to 1000 kPa (150 psig). This pressure shall be held for a minimum of 4 hours. Means of pressurizing shall be disconnected prior to the start of the 4-hour pressure holding period. If the pressure cannot be held for the specified length of time, the cause of the pressure loss shall be determined, corrected, and all of the hydrostatic pressure cycling and tests repeated.

END OF SECTION

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SECTION 02556

GAS DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA Manual	(1994; addenda/correction Jan 1996) A.G.A. Plastic Pipe Manual for Gas Service
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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B109.2	(1992) Diaphragm Type Gas Displacement Meters (500 Cubic Feet per Hour Capacity and Over)
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AMERICAN PETROLEUM INSTITUTE (API)

API Spec 5L	(1995; Errata Dec 1997) Line Pipe
API Spec 6D	(1994; Supple 1 June 1996; Supple 2 Dec, 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 181/A 181M	(1995b) Carbon Steel Forgings, for General-Purpose Piping
ASTM D 2513	(1998) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings
ASTM D 2517	(1994) Reinforced Epoxy Resin Gas Pressure Pipe and Fittings
ASTM D 2683	(1995) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 3261	(1999) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1997) PTFE Resin-Skived Tape

ASTM D 3350	(1998a) Polyethylene Plastics Pipe and Fittings Materials
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AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.40	(1985; R 1994) Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems
ASME B31.8	(1995) Gas Transmission and Distribution Piping Systems
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage

CODE OF FEDERAL REGULATIONS (CFR)

49 CFR 192	Transportation of Natural and Other Gas by Pipeline: Minimum Federal Safety Standards
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COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-2962	(Rev A) Enamel, Alkyd (Metric)
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FEDERAL SPECIFICATIONS (FS)

FS TT-E-2784	(Rev A) Enamel (Acrylic-Emulsion, Exterior Gloss and Semigloss) (Metric)
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
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NACE INTERNATIONAL (NACE)

NACE RP0185	(1996) Extruded, Polyolefin Resin Coating Systems with Soft Adhesives for Underground or Submerged Pipe
NACE RP0274	(1998) High Voltage Electrical Inspection of Pipeline Coatings Prior to Installation

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (Without Lead and Chromate Pigments)
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning
SSPC SP 7/NACE 4	(1994) Brush-Off Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL Gas & Oil Dir.	(1996; Supple) Gas and Oil Equipment Directory
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Pipe, Fittings, and Associated Materials; G

Drawings shall contain complete schematic and piping diagrams and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of the system and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Materials and Equipment; G

A complete list of equipment and materials, including manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions, including, but not limited to the following:

- a. Dielectric Unions and Flange Kits.
- b. Meters.
- c. Pressure Reducing Valves.
- d. Regulators.
- e. Earthquake Actuated Automatic Gas Shutoff System
- f. Emergency Gas Supply Connection.

Spare Parts Data;

Spare parts lists for each different item of material and equipment specified, after approval of the detail drawings and not later than 3 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Connections to Existing Lines;

Notification of the Contractor's schedule for making connections to existing gas lines, at least 10 days in advance.

Welding Steel Piping;

A copy of qualified welding procedures along with a list of names and identification symbols of performance qualified welders and welding operators.

Jointing Polyethylene and Fiberglass Piping; G

A copy of qualified jointing procedures, training procedures, qualifications of trainer, and training test results for joiners and inspectors.

Connection and Abandonment Plan; G

A copy of procedures for gas line tie in, hot taps, abandonment/removal or demolition, purging, and plugging as applicable in accordance with ASME B31.8.

SD-07 Certificates

Utility Work;

Certification from the Operating Agency/Utility Company that work for which the Utility is responsible has been completed.

Training;

A copy of each inspector's and joiner's training certificate with respective test results.

SD-10 Operation and Maintenance Data

Gas Distribution System;

Six copies, in booklet form and indexed, of site specific natural gas operation and maintenance manual for each gas distribution system including system operation, system maintenance, equipment operation, and equipment maintenance manuals described below. If operation and maintenance manuals are provided in a common volume, they shall be clearly differentiated and separately indexed.

The System Operation Manual shall include but not be limited to the following:

- a. Maps showing piping layout and locations of all system valves and gas line markers.
- b. Step-by-step procedures required for system startup, operation, and shutdown. System components and equipment shall be indexed to the gas maps.
- c. Isolation procedures and valve operations to shut down or isolate each section of the system. Valves and other system components shall be indexed to the gas maps.
- d. Descriptions of Site Specific Standard Operation Procedures including permanent and temporary pipe repair procedures, system restart and test procedures for placing repaired lines back in service, and procedures for abandoning gas piping and system components.
- e. Descriptions of Emergency Procedures including: isolation procedures including required valve operations with valve locations indexed to gas map, recommended emergency equipment, checklist for major emergencies and procedures for connecting emergency gas supply.

The Equipment Operation Manual shall include, but not be limited to, detail drawings, equipment data, and manufacturer supplied operation manuals for all equipment, valves and system components.

The System Maintenance Manuals shall include, but not be limited to:

- a. Maintenance check list for entire gas distribution system.
- b. Descriptions of site specific standard maintenance procedures.
- c. Maintenance procedures for installed cathodic protection systems.
- d. Piping layout, equipment layout, and control diagrams of the systems as installed.
- e. Identification of pipe materials and manufacturer by location, pipe repair procedures, and jointing procedures at transitions to other piping materials or piping from different manufacturer.

The Equipment Maintenance Manuals shall include but not be limited to the following:

- a. Identification of valves and other equipment by materials, manufacturer, vendor identification and location.
- b. Maintenance procedures and recommended maintenance tool kits for all valves and equipment.
- c. Recommended repair methods, either field repair, factory repair, or whole-item replacement for each valve component or piece of equipment or component item.
- d. Routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide.

1.3 GENERAL REQUIREMENTS

1.3.1 Jointing Polyethylene and Fiberglass Piping

Piping shall be joined by performance qualified joiners using qualified procedures in accordance with AGA Manual. Manufacturer's prequalified joining procedures shall be used. Joints shall be inspected by an inspector qualified in the joining procedures being used and in accordance with AGA Manual. Joiners and inspectors shall be qualified at the jobsite by a person who has been trained and certified by the manufacturer of the pipe, to train and qualify joiners and inspectors in each joining procedure to be used on the job. Training shall include use of equipment, explanation of the procedure, and successfully making joints which pass tests specified in AGA Manual. The Contracting Officer shall be notified at least 24 hours in advance of the date to qualify joiners and inspectors.

1.3.2 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site. Valves, flanges, and fittings shall be marked in accordance with MSS SP-25.

1.3.3 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.4 Handling

Pipe and components shall be handled carefully to ensure a sound, undamaged condition. Particular care shall be taken not to damage pipe coating. No pipe or material of any kind shall be placed inside another pipe or fitting after the coating has been applied, except as specified in paragraph INSTALLATION. Plastic pipe shall be handled in conformance with AGA Manual.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS, AND ASSOCIATED MATERIALS

2.1.1 Steel Pipe

Steel pipe shall conform to ASTM A 53, Grade A or B, Type E or S, Schedule 40; or API Spec 5L seamless or electric resistance welded, Schedule 40, black steel pipe as specified in ASME B31.8. Furnace butt welded pipe may be used in sizes 40 mm (1-1/2 inches) and smaller.

2.1.2 Small Fittings

Fittings 40 mm (1-1/2 inches) and smaller shall conform to ASME B16.11.

2.1.3 Fittings, 50 mm (2 Inches) and Larger

Pipe flanges and flanged fittings including bolts, nuts, and bolt patterns shall be in accordance with ASME B16.5, Class 150. Butt weld fittings shall be in accordance with ASME B16.9. Weld neck flanges shall be used.

2.1.4 Steel Forged Branch Connections

Connections shall conform to ASTM A 181/A 181M, Class 60, carbon steel.

2.1.5 Flange Gaskets

Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) minimum thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with nitrile butadiene rubber (NBR), or glass fibers bonded with polytetrafluoroethylene, suitable for maximum 315 degrees C (600 degrees F) service and meeting applicable requirements of ASME B31.8.

2.1.6 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.7 Polyethylene Pipe, Tubing, Fittings and Joints

Polyethylene pipe, tubing, fittings and joints shall conform to ASTM D 3350 and ASTM D 2513, pipe designations PE 2406 and PE 3408, rated SDR 11.5 or less, as specified in ASME B31.8. Pipe sections shall be marked as required by ASTM D 2513. Butt fittings shall conform to ASTM D 3261 and socket fittings shall conform to ASTM D 2683. Fittings shall match the service rating of the pipe.

2.1.8 Fiberglass Pipe, Fittings and Adhesive

Fiberglass pipe, fittings and adhesive shall conform to ASTM D 2517. Pipe sections shall be marked as required by ASTM D 2517.

2.1.9 Sealants for Steel Pipe Threaded Joints

2.1.9.1 Sealing Compound

Joint sealing compound shall be as listed in UL Gas & Oil Dir., Class 20 or less.

2.1.9.2 Tape

Polytetrafluoroethylene tape shall conform to ASTM D 3308.

2.1.10 Identification

Pipe flow markings and metal tags for each valve, meter, and regulator shall be provided as required by the Contracting Officer.

2.1.11 Insulating Joint Materials

Insulating joint materials shall be provided between flanged or threaded metallic pipe systems where shown to isolate galvanic or electrolytic action.

2.1.11.1 Threaded Joints

Joints for threaded pipe shall be steel body nut type dielectric type unions with insulating gaskets.

2.1.11.2 Flanged Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts and insulating washers for flange nuts.

2.1.12 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing steel and polyethylene or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transition fittings.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Steel Valves

Steel valves 40 mm (1-1/2 inches) and smaller installed underground shall conform to ASME B16.34, carbon steel, socket weld ends, with square wrench operator adapter. Steel valves 40 mm (1-1/2 inches) and smaller installed aboveground shall conform to ASME B16.34, carbon steel, socket weld or threaded ends with handwheel or wrench operator. Steel valves 50 mm (2 inches) and larger installed underground shall conform to API Spec 6D, carbon steel, butt weld ends, Class 150 with square wrench operator adapter. Steel valves 50 mm (2 inches) and larger installed aboveground shall conform to API Spec 6D, carbon steel, butt weld or flanged ends, Class 150 with handwheel or wrench operator.

2.2.2 Steel Valve Operators

Valves 200 mm (8 inches) and larger shall be provided with worm or spur gear operators, totally enclosed, grease packed, and sealed. The operators shall have Open and Closed stops and position indicators. Locking feature shall be provided where indicated. Wherever the lubricant connections are not conveniently accessible, suitable extensions for the application of lubricant shall be provided. Valves shall be provided with lubricant compatible with gas service.

2.2.3 Polyethylene Valves

Polyethylene valves shall conform to ASME B16.40. Polyethylene valves, in sizes 15 mm to 150 mm (1/2 inch to 6 inches), may be used with polyethylene distribution and service lines, in lieu of steel valves, for underground installation only.

2.3 PRESSURE REGULATORS

Regulators shall have ferrous bodies, shall provide backflow and vacuum protection, and shall be designed to meet the pressure, load and other service conditions.

2.3.1 Gas Main Regulators

Pressure regulators for main distribution lines, supplied from a source of gas which is at a higher pressure than the maximum allowable operating pressure for the system, and shall be equipped with pressure regulating devices of adequate capacity. In addition to the pressure regulating devices, a suitable method shall be provided to prevent overpressuring of the system in accordance with ASME B31.8. Suitable protective devices are as follows:

- a. Spring-loaded relief valve meeting the provisions of ASME BPV VIII Div 1.
- b. Pilot-loaded back pressure regulator used as relief valve, so designed that failure of the pilot system will cause the regulator to open.
- c. Weight-loaded relief valves.
- d. Monitoring regulator installed in series with the primary pressure regulator.
- e. Series regulator installed upstream from the primary regulator, set to limit the pressure on the inlet of the primary regulator continuously to the maximum allowable operating pressure of the system, or less.
- f. Automatic shutoff device installed in series with the primary regulator, set to shut off when the pressure on the distribution system reaches the maximum allowable operating pressure of the system, or less. This device shall remain closed until manually reset.
- g. Spring-loaded, diaphragm type relief valves.

2.3.2 Service Line Regulators

Pressure regulators for individual service lines shall have ferrous bodies. Regulator shall be capable of reducing distribution line pressure to pressures required for users. Regulators

shall be provided where gas will be distributed at pressures in excess of 2.5 kPa (10 inches of water column). Pressure relief shall be set at a lower pressure than would cause unsafe operation of any connected user. Regulators for liquefied petroleum gas shall be adjusted to 2.5 to 3 kPa (10 to 12 inches of water column). Pressure relief for liquefied petroleum gas shall be set at 4 kPa (16 inches of water column). Regulator shall have single port with orifice diameter no greater than that recommended by the manufacturer for the maximum gas pressure at the regulator inlet. Regulator valve vent shall be of resilient materials designed to withstand flow conditions when pressed against the valve port. Regulator shall be capable of regulating downstream pressure within limits of accuracy and shall be capable of limiting the buildup of pressure under no-flow conditions to 50 percent or less of the discharge pressure maintained under flow conditions. Regulator shall have a self contained service regulator. Regulator pipe connections shall not exceed 50 mm (2 inch).

2.4 METERS

Meters shall conform to ANSI B109.2. Meters shall be pipe or pedestal mounted and be provided with a strainer immediately upstream. Meters shall be provided with over-pressure protection as specified in ASME B31.8, tamper-proof protection, and frost protection. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with no false pulses and shall require no field adjustments. Initiators shall provide the maximum number of pulses up to 500 per minute that is obtainable from the manufacturer. It shall provide not less than one pulse per 2.83 cubic meter (100 cubic feet) of gas.

2.5 EARTHQUAKE ACTUATED AUTOMATIC GAS SHUTOFF SYSTEM

Earthquake Actuated Automatic Gas Shutoff devices shall conform to ASCE 25-97 Earthquake Actuated Automatic Gas Shutoff Devices and shall safely interrupt the flow of gas to the building due to strong ground shaking of an earthquake.

2.6 EMERGENCY GAS SUPPLY CONNECTION

The propane-air emergency gas supply connection shall consist of piping (same size as service line) and accessories that will enable the propane storage, vaporizer, and air mixing system to supply gas to the piping system. This connection shall be tied into the building piping system, downstream of the gas utility meter and shall be provided with a lockable manual valve.

2.7 PROTECTIVE COVERING MATERIALS

Continuously extruded polyethylene and adhesive coating system materials shall conform to NACE RP0185, Type A.

2.8 TELEMETERING OR RECORDING GAUGES

Each distribution system supplied by more than one district pressure regulating station shall be equipped with telemetering or recording pressure gauges to indicate the gas pressure in the district line.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS MAINS

Pipe for gas mains shall be steel, polyethylene, or fiberglass. Steel pipe and fittings shall be coated with protective covering as specified. Polyethylene or fiberglass mains shall not be installed aboveground.

3.3 SERVICE LINES AND EMERGENCY GAS SUPPLY CONNECTION

Service lines shall be constructed of materials specified for gas mains and shall extend from a gas main to and including the point of delivery within 1.5 meters (5 feet) of the building. The point of delivery is the meter set assembly. Service line shall be provided with an isolation valve of the same size as the service line. The service lines shall be as short and as straight as practicable between the point of delivery and the gas main and shall not be bent or curved laterally unless necessary to avoid obstructions or otherwise permitted. Service lines shall be laid with as few joints as practicable using standard lengths of pipe. Shorter lengths shall be used only for closures. Polyethylene or fiberglass service lines shall not be installed aboveground except as permitted in ASME B31.8.

3.4 WORKMANSHIP AND DEFECTS

Pipe, tubing, and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and blown free of chips and scale. Defective pipe, tubing, or fittings shall be replaced and shall not be repaired.

3.5 PROTECTIVE COVERING

3.5.1 Protective Covering for Underground Steel Pipe

Except as otherwise specified, protective coverings shall be applied mechanically in a factory or field plant especially equipped for the purpose. Valves and fittings that cannot be coated and wrapped mechanically shall have the protective covering applied by hand, preferably at the plant that applies the covering to the pipe. Joints shall be coated and wrapped by hand. Hand coating and wrapping shall be done in a manner and with materials that will produce a covering equal in thickness to that of the covering applied mechanically.

3.5.1.1 Thermoplastic Resin Coating System

The coating system shall conform to NACE RP0185, Type A. The exterior of the pipe shall be cleaned to a commercial grade blast cleaning finish in accordance with SSPC SP 6/NACE 3. Adhesive compound shall be applied to the pipe. Immediately after the adhesive is applied, a seamless tube of polyethylene shall be extruded over the adhesive to produce a bonded seamless coating. The nominal thickness of the pipe coating system shall be 0.25 mm (10 mils) (plus or minus 10 percent) of adhesive and 1.0 mm (40 mils) (plus or minus 10 percent) of polyethylene for pipes up to 400 mm (16 inches) 16 inches in diameter. Joint

coating and field repair material shall be applied as recommended by the coating manufacturer and shall be one of the following:

- a. Heat shrinkable polyethylene sleeves.
- b. Polyvinyl chloride pressure-sensitive adhesive tape.
- c. High density polyethylene/bituminous rubber compound tape.

The coating system shall be inspected for holes, voids, cracks, and other damage during installation.

3.5.1.2 Inspection of Pipe Coatings

Any damage to the protective covering during transit and handling shall be repaired before installation. After field coating and wrapping has been applied, the entire pipe shall be inspected by an electric holiday detector with impressed current set at a value in accordance with NACE RP0274 using a full-ring, spring-type coil electrode. The holiday detector shall be equipped with a bell, buzzer, or other type of audible signal which sounds when a holiday is detected. All holidays in the protective covering shall be repaired immediately upon detection. The Contracting Officer reserves the right to inspect and determine the suitability of the detector. Labor, materials, and equipment necessary for conducting the inspection shall be furnished by the Contractor.

3.5.2 Protective Covering for Aboveground Piping Systems

Finish painting shall conform to the applicable paragraphs of Section 09900 PAINTING, GENERAL and as follows:

3.5.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer same type paint as the shop primer. Surfaces that have not been shop primed shall be solvent-cleaned in accordance with SSPC SP 1. Surfaces that contain loose rust, loose mill scale, and other foreign substances shall be mechanically cleaned by power wire brushing in accordance with SSPC SP 3 or brush-off blast cleaned in accordance with SSPC SP 7/NACE 4 and primed with ferrous metal primer in accordance with SSPC Paint 25. Primed surfaces shall be finished with two coats of exterior alkyd paint conforming to CID A-A-2962 Type I, Class A or B, Grade B.

3.5.2.2 Nonferrous Surfaces

Nonferrous surfaces shall not be painted

3.5.3 Protective Covering for Piping in Valve Boxes and Manholes

Piping in valve boxes or manholes shall receive protective coating as specified for underground steel pipe.

3.6 INSTALLATION

Gas distribution system and equipment shall be installed in conformance with the manufacturer's recommendations and applicable sections of ASME B31.8, AGA Manual and 49 CFR 192. Abandoning existing gas piping shall be done in accordance with ASME B31.8. Pipe shall be cut without damaging the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 150 mm (6 inches) and larger, an approved gas-cutting-and-beveling machine may be used. Cutting of plastic pipe shall be in accordance with AGA Manual. Valve installation in plastic pipe shall be designed to protect the plastic pipe against excessive torsional or shearing loads when the valve is operated and from other stresses which may be exerted through the valve or valve box.

3.6.1 Installing Pipe Underground

Gas mains and service lines shall be graded as required or indicated. Joints in steel pipe shall be welded except as otherwise permitted for installation of valves. Mains shall have 600 mm (24 inch) minimum cover; service lines shall have 485 mm (18 inch) minimum cover; and both mains and service lines shall be placed on firmly compacted select material for the full length. Where indicated, the main shall be encased, bridged, or designed to withstand any anticipated external loads as specified in ASME B31.8. The encasement material shall be standard weight black steel pipe with a protective coating as specified. The pipe shall be separated from the casing by insulating spacers and sealed at the ends with casing bushings. Trench shall be excavated below pipe grade, bedded with bank sand, and compacted to provide full-length bearing. Laying the pipe on blocks to produce uniform grade will not be permitted. The pipe shall be clean inside before it is lowered into the trench and shall be kept free of water, soil, and all other foreign matter that might damage or obstruct the operation of the valves, regulators, meters, or other equipment. When work is not in progress, open ends of pipe or fittings shall be securely closed by expandable plugs or other suitable means. Minor changes in line or gradient of pipe that can be accomplished through the natural flexibility of the pipe material without producing permanent deformation and without overstressing joints may be made when approved. Changes in line or gradient that exceed the limitations specified shall be made with fittings. When cathodic protection is furnished, electrically insulated joints or flanges shall be provided. When polyethylene or fiberglass piping is installed underground, foil backed magnetic tape shall be placed above the pipe to permit locating with a magnetic detector. After laying of pipe and testing, trench shall be backfilled in accordance with Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITY SYSTEMS.

3.6.2 Installing Pipe Aboveground

Aboveground piping shall be protected against dirt and other foreign matter as specified for underground piping. Joints in steel pipe shall be welded; however, joints in pipe 40 mm (1-1/2 inches) in diameter and smaller may be threaded; joints may also be threaded to accommodate the installation of valves. Flanges shall be of the weld neck type to match wall thickness of pipe.

3.7 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pullout forces caused by the contraction of piping or superimposed loads.

3.7.1 Threaded Steel Joints

Threaded joints in steel pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or polytetrafluoroethylene tape applied to the male threads only. Caulking of threaded joints to stop or prevent leaks will not be permitted.

3.7.2 Welded Steel Joints

Gas pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.8. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.7.3 Polyethylene and Fiberglass Pipe Jointing Procedures

Jointing procedures shall conform to AGA Manual. Indiscriminate heat fusion joining of plastic pipe or fittings made from different polyethylene resins by classification or by manufacturer shall be avoided if other alternative joining procedures are available. If heat fusion joining of dissimilar polyethylenes is required, special procedures are required. The method of heat fusion joining dissimilar polyethylene resins shall be tested in accordance with paragraph TESTS, subparagraph Destructive Tests of Plastic Pipe Joints.

3.7.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.8 VALVE BOXES

Valve boxes of cast iron not less than 4.7 mm (3/16 inch) thick shall be installed at each underground valve except where concrete or other type of housing is indicated. Valve boxes shall be provided with locking covers that require a special wrench for removal. Wrench shall be furnished for each box. The word "gas" shall be cast in the box cover. When the valve is located in a roadway, the valve box shall be protected by a suitable concrete slab at least 1 meter (3 feet) square. When in a sidewalk, the top of the box shall be in a concrete slab 600 mm (2 feet) square and set flush with the sidewalk. Boxes shall be adjustable extension type with screw or slide-type adjustments. Valve boxes shall be separately supported, not resting on the pipe, so that no traffic loads can be transmitted to the pipe. Valves shall only be located in valve boxes or inside of buildings.

3.9 DRIPS

Drips shall be installed at all locations of low points, and additionally, where indicated. Drips shall conform to the details shown or may be commercial units of approved type and capacity. A blow off pipe 32 mm (1-1/4 inches) or larger shall be connected to each drip at its lowest point and shall extend to or near the ground surface at a convenient location away from traffic. Discharge for each drip terminal (outlet) shall be provided with a reducing fitting, a plug valve, and a 15 mm (1/2 inch) nipple turned down. The discharge terminal (outlet) shall be inside a length of 300 mm (12 inches) or larger vitrified clay pipe, concrete sewer pipe or concrete terminal box [set vertically on a bed of coarse gravel 300 mm (1 foot thick) and 1 m (3 feet) square, with concrete bottom to contain liquids and a connection to remove liquids for disposal, and closed at the ground surface with a suitable replacement cover.

3.10 PRESSURE REGULATOR INSTALLATION

3.10.1 Main Distribution Line Regulators

Pressure regulators shall be installed where shown. A valve shall be installed on each side of the regulator for isolating the regulator for maintenance. A bypass line with bypass valves or 3 way valves and an overpressurization pressure regulating device shall be provided.

3.10.2 Service Line Regulators

A shutoff valve, meter set assembly, and service regulator shall be installed on the service line outside the building, 450 mm (18 inches) above the ground on the riser. An insulating joint shall be installed on the inlet side of the meter set assembly and service regulator and shall be constructed to prevent flow of electrical current. A 10 mm (3/8 inch) tapped fitting equipped with a plug shall be provided on both sides of the service regulator for installation of pressure gauges for adjusting the regulator. All service regulator vents and relief vents shall terminate in the outside air in rain and insect resistant fittings. The open end of the vent shall be located where gas can escape freely into the atmosphere, away from any openings into the building and above areas subject to flooding.

3.11 METER INSTALLATION

Meters shall be installed in accordance with ASME B31.8. Permanent gas meters shall be installed with provisions for isolation and removal for calibration and maintenance, and shall be suitable for operation in conjunction with an energy monitoring and control system.

3.12 CONNECTIONS TO EXISTING LINES

Connections between new work and existing gas lines, where required, shall be made in accordance with ASME B31.8, using proper fittings to suit the actual conditions. When connections are made by tapping into a gas main, the connecting fittings shall be the same size as the pipe being connected.

3.12.1 Connections to Publicly or Privately Operated Gas Utility Lines

Contractor shall provide materials for the connections to the existing gas lines. Final connections and the turning on of gas shall be made by the utility. Existing lines that are to be abandoned or taken out of service shall be disconnected, purged and capped, plugged

or otherwise effectively sealed by the Utility. The Contractor shall notify the Contracting Officer, in writing, 10 days before final connections and turning on of gas lines. The Contractor shall make necessary arrangements with the Utility for tie in and activation of new gas lines. Only the Operating Agency/Utility Company may reactivate the system after tie in. The Contractor shall furnish a certification by the Operating Agency/Utility Company that all Utility work has been satisfactorily completed.

3.13 (Not Used)

3.14 TESTS

3.14.1 Destructive Tests of Plastic Pipe Joints

Each day, prior to making polyethylene heat fusion joints or fiberglass adhesive joints, a joint of each size and type to be installed that day shall be made by each person performing joining of plastic pipe that day and destructively tested. At least 3 longitudinal straps shall be cut from each joint. Each strap shall be visually examined, shall not contain voids or discontinuities on the cut surfaces of the joint area, and shall be deformed by bending, torque, or impact, and if failure occurs, it must not initiate in the joint area. If a joint fails the visual or deformation test, the qualified joiner who made that joint shall not make further field joints in plastic pipe on this job until that person has been retrained and requalified. The results of the destructive tests shall be recorded to include the date and time of the tests, size and type of the joints, ambient conditions, fusion iron temperature and names of inspectors and joiners.

3.14.2 Pressure and Leak Tests

The system of gas mains and service lines shall be tested after construction and before being placed in service using air as the test medium. The normal operating pressure for the system is 50 psig. The test pressure is 75 psig]. Prior to testing the system, the interior shall be blown out, cleaned and cleared of all foreign materials. All meters, regulators, and controls shall be removed before blowing out and cleaning and reinstalled after clearing of all foreign materials. Testing of gas mains and service lines shall be done with due regard for the safety of employees and the public during the test. Persons not working on the test operations shall be kept out of the testing area while testing is proceeding. The test shall be made on the system as a whole or on sections that can be isolated. Joints in sections shall be tested prior to backfilling when trenches must be backfilled before the completion of other pipeline sections. The test shall continue for at least 24 hours from the time of the initial readings to the final readings of pressure and temperature. The initial test readings of the instrument shall not be made for at least 1 hour after the pipe has been subjected to the full test pressure, and neither the initial nor final readings shall be made at times of rapid changes in atmospheric conditions. The temperatures shall be representative of the actual trench conditions. There shall be no indication of reduction of pressure during the test after corrections have been made for changes in atmospheric conditions in conformity with the relationship $T(1)P(2)=T(2)P(1)$, in which T and P denote absolute temperature and pressure, respectively, and the numbers denote initial and final readings. During the test, the entire system shall be completely isolated from all compressors and other sources of air pressure. Each joint shall be tested by means of soap and water or an equivalent nonflammable solution prior to backfilling or concealing any work. The testing instruments shall be approved by the Contracting Officer. All labor, materials and equipment for conducting the tests shall be furnished by the Contractor and shall be subject to inspection at all times during the tests.

The Contractor shall maintain safety precautions for air pressure testing at all times during the tests.

END OF SECTION

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SECTION 02620

SUBSURFACE DRAINAGE (LEACHING) CHAMBER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO –01 (1990), 14TH Ed.) Standard
Specification s for Highway Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1248 (1984 w Rev 1989(Standard
Specification for Polyethylene
Plastics
Molding and Extrusion

1.2 SUBMITTALS

Government approval is required for submittals with a “G” designation; submittals not having a “G” designation are for information only. When used, a designation following the “G” designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Data

Leaching Chamber;

Data shall consist of manufacturer’s descriptive and technical literature for leaching chamber

Instructions

Installation Procedures;

Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Contracting Officer prior to installation.

1.3 DELIVERY, STORAGE AND HANDLING

1.3.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unleaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and exposure to the direct sunlight over extended periods.

1.3.2 Handling

Materials shall be handled in such a manner as to insure delivery to the trench in sound, undamaged condition.

1.4 DESIGN REQUIREMENTS

Installed leaching system with 450 mm backfill cover shall meet H-20 load rating under AASHTO-01

PART 2 – PRODUCTS

2.1 Subsurface Drainage (Leaching) Chamber

The subsurface drainage (leaching) chamber, is system to receive effluent and allow it to drain or infiltrate into the surrounding soil.

2.1.1 Provide standard manufactured units for this purpose formed of high density molded polyethylene conforming to the following:

- a. Units shall be arch shaped, with open-bottom.
- b. Nominal size of individual units shall be 850 mm width by 350 mm (min.) depth by 1875 mm length.
- c. Each unit shall have a minimum of .03 square meter of sidewall opening per linear 300 mm. Openings shall be 0.5 mm wide.
- d. Each unit shall have a minimum bearing footprint of 0.14 to 0.19 square meters.
- e. Units shall include standard end plates and access ports of 150 mm diameter pipe.
- f. Each unit shall be designed with interlocking joints for field installation.
- g. Polyethylene used in molded units shall have a minimum density of 0.095 gm/cm³

PART 3 – EXECUTION

3.1 INSTALLATION

3.1.1 Drainage (Leaching) Chambers

Excavation of trenches and backfilling for the subsurface drainage (leaching) chambers shall be in accordance with the applicable portion of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS and the installation of the subsurface (leaching) chambers shall be in accordance with the manufacturer's recommendations except provide 300 mm of drain gravel below and at the sidewalls of the chambers.

END OF SECTION

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SECTION 02630

STORM-DRAINAGE SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION
OFFICIALS (AASHTO)

AASHTO HB-16 (1996) Standard Specifications for Highway Bridges

AASHTO M 198 (1998) Joints for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE-OF-WAY
ASSOCIATION (AREMA)

AREMA Manual (1999) Manual for Railway Engineering (4 Vol.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48 (1994a) Gray Iron Castings

ASTM A 48M (1994 el) Gray Iron Castings (Metric)

ASTM A 123/A 123M (1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron
and Steel Products

ASTM A 536 (1999el) Ductile Iron Castings

ASTM B 26/B 26M (1998) Aluminum-Alloy Sand Castings

ASTM C 14M (1999) Concrete Sewer, Storm Drain, and Culvert Pipe
(Metric)

ASTM C 76M (1999a) Reinforced Concrete Culvert, Storm Drain, and
Sewer Pipe (Metric)

ASTM C 231 (1997el) Air Content of Freshly Mixed Concrete by the
Pressure Method

ASTM C 443M	(1998) Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets (Metric)
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM C 655	(1995a) Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe
ASTM C 923	(1998) Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Materials
ASTM C 924	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method
ASTM C 924M	(1998) Concrete Pipe Sewer Lines by Low-Pressure Air Test Method (Metric)
ASTM C 1103M	(1994) Joint Acceptance Testing of Installed Precast Concrete Pipe Sewer Lines (Metric)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1171	(1994) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimens)
ASTM D 1556	1990; R 1996) Density and Unit Weight of Soil in Place by the Sand-Cone Method
ASTM D 1557	(1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)

ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 3034	(1998) Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3350	(1998a) Polyethylene Plastics Pipe and Fittings Materials
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 679	(1995) Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
ASTM F 714	(1997) Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter
ASTM F 794	(1999) Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter
ASTM F 1417	(1992; R 1998) Installation Acceptance of Plastic Gravity Sewer Lines Using Low-Pressure Air

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings, G

Frame and Cover for Architectural Grates

Drawings showing scaled details of proposed Architectural Grates, dimensions, details,

Hardware, and methods of mounting, shape and thickness of materials, and details of construction for the followings:

Architectural Catch Basin Grate and Frame
Architectural Trench Grate
Architectural Yard Drain Grate and Frame

SD-03 Product Data

Placing Pipe;

Printed copies of the manufacturer's recommendations for installation procedures of the material being placed, prior to installation.

SD-07 Certificates

Resin Certification;
Pipeline Testing
Hydrostatic Test on Watertight Joints;
Determination of Density;
Frame and Cover for Gratings;

Certified copies of test reports demonstrating conformance to applicable pipe specifications, before pipe is installed. Certification on the ability of frame and cover or gratings to carry the imposed live load.

1.4 DELIVERY, STORAGE, AND HANDLING

1.4.1 Delivery and Storage

Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. Materials shall not be stored directly on the ground. The inside of pipes and fittings shall be kept free of dirt and debris. Before, during, and after installation, plastic pipe and fittings shall be protected from any environment that would result in damage or deterioration to the material. The Contractor shall have a copy of the manufacturer's instructions available at the construction site at all times and shall follow these instructions unless directed otherwise by the Contracting Officer. Solvents, solvent compounds, lubricants, elastomeric gaskets, and any similar materials required to install plastic pipe shall be stored in accordance with the manufacturer's recommendations and shall be discarded if the storage period exceeds the recommended shelf life. Solvents in use shall be discarded when the recommended pot life is exceeded.

1.4.2 Handling

Materials shall be handled in a manner that ensures delivery to the trench in sound, undamaged condition. Pipe shall be carried to the trench, not dragged.

PART 2 PRODUCTS

2.1 PIPE FOR CULVERTS AND STORM DRAINS

Pipe for culverts and storm drains shall be of the sizes indicated and shall conform to the requirements specified.

2.1.1 Concrete Pipe

ASTM C 76M , Class II, or ASTM C 655M (50 newtons per linear meter per millimeter of diameter), D?Load.

2.1.2 PVC Pipe

The pipe manufacturer's resin certification, indicating the cell classification of PVC used to manufacture the pipe, shall be submitted prior to installation of the pipe.

2.1.2.1 Type PSM PVC Pipe

ASTM D 3034, Type PSM, maximum SDR 35, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.2.2 Profile PVC Pipe

ASTM F 794, Series 46, produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.2.3 Smooth Wall PVC Pipe

ASTM F 679 produced from PVC certified by the compounder as meeting the requirements of ASTM D 1784, minimum cell class 12454-B.

2.1.3 PE Pipe

The pipe manufacturer's resin certification indicating the cell classification of PE used to manufacture the pipe shall be submitted prior to installation of the pipe. The minimum cell classification for polyethylene plastic shall apply to each of the seven primary properties of the cell classification limits in accordance with ASTM D 3350.

2.1.3.1 Smooth Wall PE Pipe

ASTM F 714, maximum DR of 21 for pipes 80 to 600 mm in diameter and maximum DR of 26 for pipes 650 to 1200 mm in diameter. Pipe shall be produced from PE certified by the resin producer as meeting the requirements of ASTM D 3350, minimum cell class 335434C.

2.2 DRAINAGE STRUCTURES

2.2.1 Flared End Sections

Sections shall be of a standard design fabricated from zinc coated steel sheets meeting requirements of ASTM A 929/A 929M.

2.2.2 Precast Reinforced Concrete Box

For highway loadings with 600 mm of cover or more or subjected to dead load only, ASTM C 789; for less than 600 mm of cover subjected to highway loading, ASTM C 850.

2.3 MISCELLANEOUS MATERIALS

2.3.1 Concrete

Unless otherwise specified, concrete and reinforced concrete shall conform to the requirements for 20 MPa concrete under Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. The concrete mixture shall have air content by volume of concrete, based on measurements made immediately after discharge from the mixer, of 5 to 7 percent when maximum size of coarse aggregate exceeds 37.5 mm. Air content shall be determined in accordance with ASTM C 231. The concrete covering over steel reinforcing shall not be less than 25 mm thick for covers and not less than 40 mm thick for walls and flooring. Concrete covering deposited directly against the ground shall have a thickness of at least 75 mm between steel and ground. Expansion-joint filler material shall conform to ASTM D 1751, or ASTM D 1752, or shall be resin-impregnated fiberboard conforming to the physical requirements of ASTM D 1752.

2.3.2 Mortar

Mortar for pipe joints, connections to other drainage structures, and brick or block construction shall conform to ASTM C 270, Type M, except that the maximum placement time shall be 1 hour. The quantity of water in the mixture shall be sufficient to produce a stiff workable mortar but in no case shall exceed 25 liters of water per sack of cement. Water shall be clean and free of harmful acids, alkalis, and organic impurities. The mortar shall be used within 30 minutes after the ingredients are mixed with water. The inside of the joint shall be wiped clean and finished smooth. The mortar head on the outside shall be protected from air and sun with a proper covering until satisfactorily cured.

2.3.3 Precast Reinforced Concrete Manholes and Catch Basins

Precast reinforced concrete manholes shall conform to ASTM C 478M ASTM C 478. Joints between precast concrete risers and tops shall be made with flexible watertight, rubber-type gaskets meeting the requirements of paragraph JOINTS.

2.3.4 Frame and Cover for Gratings

Frame and cover for gratings shall be cast gray iron, ASTM A 48M ASTM A 48, Class 35B; cast ductile iron, ASTM A 536, Grade 65-45-12; or cast aluminum, ASTM B 26/B 26M, Alloy 356.OT6. Weight, shape, size, and waterway openings for grates and curb inlets shall be as indicated on the plans, except as noted below. Architectural catch basin grates shall be OPCB design by Urban Accessories or approved equal. Architectural catch basin grates shall be 381 mm by 381 mm cast iron grate with frame designed to carry a HS-20 load. Architectural trench grate shall be OPCB design by Urban Accessories or approved equal. Architectural trench grate shall come in 125 mm by 381 mm cast iron sections designed to carry a HS-20 load. Overall length of trench grate shall be as indicated on the drawings. Architectural yard drains shall be Angle design by Urban Accessories or approved equal. Architectural yard drains shall be 300 mm diameter cast iron grate with frame designed for light traffic.

2.3.5 Joints

2.3.5.1 Flexible Watertight Joints

- a. Materials: Flexible watertight joints shall be made with plastic or rubber-type gaskets for concrete pipe and with factory-fabricated resilient materials for clay pipe. The design of joints and the physical requirements for plastic gaskets shall conform to AASHTO M 198, and rubber-type gaskets shall conform to ASTM C 443M ASTM C 443. Factory-fabricated resilient joint materials shall conform to ASTM C 425. Gaskets shall have not more than one factory-fabricated splice, except that two factory-fabricated splices of the rubber-type gasket are permitted if the nominal diameter of the pipe being gasketed exceeds 1.35 m .
- b. Test Requirements: Watertight joints shall be tested and shall meet test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS. Rubber gaskets shall comply with the oil resistant gasket requirements of ASTM C 443M. Certified copies of test results shall be delivered to the Contracting Officer before gaskets or jointing materials are installed. Alternate types of watertight joint may be furnished, if specifically approved.

2.3.5.2 External Sealing Bands

Requirements for external sealing bands shall conform to ASTM C 877M ASTM C 877.

2.3.5.3 Flexible Watertight, Gasketed Joints

- a. Gaskets: When infiltration or exfiltration is a concern for pipe lines, the couplings may be required to have gaskets. The closed-cell expanded rubber gaskets shall be a continuous band approximately 178 mm wide and approximately 10 mm, meeting the requirements of ASTM D 1056, Type 2 B3, and shall have a quality retention rating of not less than 70 percent when tested for weather resistance by ozone chamber exposure, Method B of ASTM D 1171. Rubber O-ring gaskets shall be 21 mm in diameter for pipe diameters of 914 mm or smaller and 22 mm in diameter for larger pipe having 13 mm deep end corrugation. O-rings shall meet the requirements of AASHTO M 198 or ASTM C 443 . Flexible plastic gaskets shall conform to requirements of AASHTO M 198, Type B.
- b. Connecting Bands: Connecting bands shall be of the type, size and sheet thickness of band, and the size of angles, bolts, rods and lugs as indicated or where not indicated as specified in the applicable standards or specifications for the pipe. Exterior rivet heads in the longitudinal seam under the connecting band shall be countersunk or the rivets shall be omitted and the seam welded. Watertight joints shall be tested and shall meet the test requirements of paragraph HYDROSTATIC TEST ON WATERTIGHT JOINTS.

2.3.5.4 PVC Plastic Pipes

Joints shall be solvent cement or elastomeric gasket type in accordance with the specification for the pipe and as recommended by the pipe manufacturer.

2.3.5.5 Smooth Wall PE Plastic Pipe

Pipe shall be joined using butt fusion method as recommended by the pipe manufacturer.

2.4 STEEL LADDER

Steel ladder shall be provided where the depth of the manhole exceeds 3.66 m (12 feet). 12 feet. These ladders shall be not less than 406 mm (16 inches) 16 inches in width, with 19 mm (3/4 inch) 3/4 inch diameter rungs spaced 305 mm (12 inches) 12 inches apart. The two stringers shall be a minimum 10 mm (3/8 inch) 3/8 inch thick and 63 mm (2-1/2 inches) 2-1/2 inches wide. Ladders and inserts shall be galvanized after fabrication in conformance with ASTM A 123/A 123M.

2.5 DOWNSPOUT BOOTS

Boots used to connect exterior downspouts to the storm-drainage system shall be of gray cast iron conforming to ASTM A 48M, Class 30B or 35B. Shape and size shall be as indicated.

2.6 RESILIENT CONNECTORS

Flexible, watertight connectors used for connecting pipe to manholes and inlets shall conform to ASTM C 923.

2.7 HYDROSTATIC TEST ON WATERTIGHT JOINTS

2.7.1 Concrete, PVC and PE Pipe

A hydrostatic test shall be made on the watertight joint types as proposed. Only one sample joint of each type needs testing; however, if the sample joint fails because of faulty design or workmanship, an additional sample joint may be tested. During the test period, gaskets or other jointing material shall be protected from extreme temperatures which might adversely affect the performance of such materials. Performance requirements for joints in reinforced and nonreinforced concrete pipe shall conform to AASHTO M 198 or ASTM C 443M. Test requirements for joints in PVC and PE plastic pipe shall conform to ASTM D 3212.

PART 3 EXECUTION

3.1 EXCAVATION FOR PIPE CULVERTS, STORM DRAINS, AND DRAINAGE STRUCTURES

Excavation of trenches, and for appurtenances and backfilling for culverts and storm drains, shall be in accordance with the applicable portions of Section 02316 "Excavation, Trenching, and Backfilling for Utilities Systems" and the requirements specified below.

3.1.1 Trenching

The width of trenches at any point below the top of the pipe shall be not greater than the outside diameter of the pipe plus 600 mm to permit satisfactory jointing and thorough tamping of the bedding material under and around the pipe. Sheet piling and bracing, where required, shall be placed within the trench width as specified. Contractor shall not

overexcavate. Where trench widths are exceeded, redesign with a resultant increase in cost of stronger pipe or special installation procedures will be necessary. Cost of this redesign and increased cost of pipe or installation shall be borne by the Contractor without additional cost to the Government.

3.1.2 Removal of Unstable Material

Where wet or otherwise unstable soil incapable of properly supporting the pipe, as determined by the Contracting Officer, is unexpectedly encountered in the bottom of a trench, such material shall be removed to the depth required and replaced to the proper grade with select granular material, compacted as provided in paragraph BACKFILLING. When removal of unstable material is due to the fault or neglect of the Contractor in his performance of shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the government.

3.2 BEDDING

The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.2.1 Concrete Pipe Requirements

When no bedding class is specified or detailed on the drawings, concrete pipe shall be bedded in a soil foundation accurately shaped and rounded to conform to the lowest one-fourth of the outside portion of circular pipe or to the lower curved portion of pipe arch for the entire length of the pipe or pipe arch. When necessary, the bedding shall be tamped. Bell holes and depressions for joints shall be not more than the length, depth, and width required for properly making the particular type of joint.

3.2.2 Plastic Pipe

Bedding for PVC and PE pipe shall meet the requirements of ASTM D 2321. Bedding, haunching, and initial backfill shall be either Class IB or II material.

3.3 PLACING PIPE

Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Plastic pipe shall be protected from exposure to direct sunlight prior to laying, if necessary to maintain adequate pipe stiffness and meet installation deflection requirements. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Lifting lugs in vertically elongated metal pipe shall be placed in the same vertical plane as the major axis of the pipe. Pipe shall not be laid in water, and pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches during construction shall be provided as necessary. Deflection of installed flexible pipe shall not exceed the following limits:

TYPE OF PIPE	MAXIMUM ALLOWABLE DEFLECTION (%)
Plastic	7.5

Not less than 30 days after the completion of backfilling, the Government may perform a deflection test on the entire length of installed flexible pipe using a mandrel or other suitable device. Installed flexible pipe showing deflections greater than those indicated above shall be retested by a run from the opposite direction. If the retest also fails, the suspect pipe shall be replaced at no cost to the Government.

3.3.1 Concrete, and PVC

Laying shall proceed upgrade with spigot ends of bell-and-spigot pipe and tongue ends of tongue-and-groove pipe pointing in the direction of the flow.

3.3.2 Multiple Culverts

Where multiple lines of pipe are installed, adjacent sides of pipe shall be at least half the nominal pipe diameter or 1 meter apart, whichever is less.

3.4 JOINTING

3.4.1 Concrete Pipe

3.4.1.1 Flexible Watertight Joints

Gaskets and jointing materials shall be as recommended by the particular manufacturer in regard to use of lubricants, cements, adhesives, and other special installation requirements. Surfaces to receive lubricants, cements, or adhesives shall be clean and dry. Gaskets and jointing materials shall be affixed to the pipe not more than 24 hours prior to the installation of the pipe, and shall be protected from the sun, blowing dust, and other deleterious agents at all times. Gaskets and jointing materials shall be inspected before installing the pipe; any loose or improperly affixed gaskets and jointing materials shall be removed and replaced. The pipe shall be aligned with the previously installed pipe, and the joint pushed home. If, while the joint is being made the gasket becomes visibly dislocated the pipe shall be removed and the joint remade.

3.4.1.2 Flexible Watertight, Gasketed Joints

Installation shall be as recommended by the gasket manufacturer for use of lubricants and cements and other special installation requirements. The gasket shall be placed over one end of a section of pipe for half the width of the gasket. The other half shall be doubled over the end of the same pipe. When the adjoining section of pipe is in place, the doubled-over half of the gasket shall then be rolled over the adjoining section. Any unevenness in overlap shall be corrected so that the gasket covers the end of pipe sections equally. Connecting bands shall be centered over adjoining sections of pipe, and rods or bolts placed in position and nuts tightened. Band Tightening: The band shall be tightened evenly, even tension being kept on the rods or bolts, and the gasket; the gasket shall seat properly in the corrugations. Watertight joints shall remain uncovered for a period of time designated, and before being covered, tightness of the nuts shall be measured with a torque wrench. If the nut has tended to loosen its grip on the bolts or rods, the nut shall be retightened with a torque wrench and remain uncovered until a tight, permanent joint is assured.

3.5 DRAINAGE STRUCTURES

3.5.1 Manholes and Inlets

Construction shall be of precast reinforced concrete; complete with frames and covers or gratings; and with fixed galvanized steel ladders where indicated. Pipe connections to concrete manholes and inlets shall be made with flexible, watertight connectors.

3.5.2 Walls and Headwalls

Construction shall be as indicated.

3.6 STEEL LADDER INSTALLATION

Ladder shall be adequately anchored to the wall by means of steel inserts spaced not more than 1.83 m vertically, and shall be installed to provide at least 152 mm of space between the wall and the rungs. The wall along the line of the ladder shall be vertical for its entire length.

3.7 BACKFILLING

3.7.1 Backfilling Pipe in Trenches

After the pipe has been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layers not exceeding 150 mm in compacted depth. The backfill shall be brought up evenly on both sides of pipe for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 300 mm above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 200 millimeters. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Contracting Officer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.7.2 Movement of Construction Machinery

When compacting by rolling or operating heavy equipment parallel with the pipe, displacement of or injury to the pipe shall be avoided. Movement of construction machinery over a culvert or storm drain at any stage of construction shall be at the Contractor's risk. Any damaged pipe shall be repaired or replaced.

3.7.3 Compaction

3.7.3.1 General Requirements

Cohesionless materials include gravels, gravel-sand mixtures, sands, and gravelly sands. Cohesive materials include clayey and silty gravels, gravel-silt mixtures, clayey and silty sands, sand-clay mixtures, clays, silts, and very fine sands. When results of compaction tests for moisture-density relations are recorded on graphs, cohesionless soils will show straight

lines or reverse-shaped moisture-density curves, and cohesive soils will show normal moisture-density curves.

3.7.3.2 Minimum Density

Backfill over and around the pipe and backfill around and adjacent to drainage structures shall be compacted at the approved moisture content to the following applicable minimum density, which will be determined as specified below.

- a. Under paved roads, streets, parking areas, and similar-use pavements including adjacent shoulder areas, the density shall be not less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material, up to the elevation where requirements for pavement subgrade materials and compaction shall control.
- b. Under unpaved or turfed traffic areas, density shall not be less than 90 percent of maximum density for cohesive material and 95 percent of maximum density for cohesionless material.
- c. Under non-traffic areas, density shall be not less than that of the surrounding material.

3.7.4 Determination of Density

Testing shall be the responsibility of the Contractor and performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory . Tests shall be performed in sufficient number to ensure that specified density is being obtained. Laboratory tests for moisture-density relations shall be made in accordance with ASTM D 1557 except that mechanical tampers may be used provided the results are correlated with those obtained with the specified hand tamper. Field density tests shall be determined in accordance with ASTM D 1556, ASTM D 2167 or ASTM D 2922. When ASTM D 2922 is used, the calibration curves shall be checked and adjusted, if necessary, using the sand cone method as described in paragraph Calibration of the referenced publications. ASTM D 2922 results in a wet unit weight of soil and when using this method ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall be checked along with density calibration checks as described in ASTM D 3017 or ASTM D 2922. Test results shall be furnished the Contracting Officer. The calibration checks of both the density and moisture gauges shall be made at the beginning of a job on each different type of material encountered and at intervals as directed.

3.8 PIPELINE TESTING

Lines shall be tested for leakage by low pressure air or water testing or exfiltration tests, as appropriate. Low pressure air testing for concrete pipes shall conform to ASTM C 924M. Low pressure air testing for plastic pipe shall conform to ASTM F 1417. Low pressure air testing procedures for other pipe materials shall use the pressures and testing times prescribed in ASTM C 828 or ASTM C 924M , after consultation with the pipe manufacturer. Testing of individual joints for leakage by low pressure air or water shall conform to ASTM C 1103M. Prior to exfiltration tests, the trench shall be backfilled up to at least the lower half of the pipe. If required, sufficient additional backfill shall be placed to prevent pipe movement during testing, leaving the joints uncovered to permit inspection. Visible leaks encountered shall be

corrected regardless of leakage test results. When the water table is 600 mm or more above the top of the pipe at the upper end of the pipeline section to be tested, infiltration shall be measured using a suitable weir or other device acceptable to the Contracting Officer. An exfiltration test shall be made by filling the line to be tested with water so that a head of at least 600 mm is provided above both the water table and the top of the pipe at the upper end of the pipeline to be tested. The filled line shall be allowed to stand until the pipe has reached its maximum absorption, but not less than 4 hours. After absorption, the head shall be reestablished. The amount of water required to maintain this water level during a 2-hour test period shall be measured. Leakage as measured by the exfiltration test shall not exceed 9 ml per mm in diameter per 100 meters. When leakage exceeds the maximum amount specified, satisfactory correction shall be made and retesting accomplished. Testing, correcting, and retesting shall be made at no additional cost to the Government.

END OF SECTION

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SECTION 02722

AGGREGATE BASE COURSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and an 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 127	(1988; R 1993el) Specific Gravity and Absorption of Course Aggregate
ASTM C 128	(1997) Specific Gravity and Absorption of Fine Aggregate
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM D 75	(1987; R 1997) Sampling Aggregates
ASTM D 422	(1963; R 1998) Particle-Size Analysis of Soils
ASTM D 1556	(1990; R 1996el) Density and Unit Weight of Soil in Place by the Sand-Cone Method

ASTM D 1557	(1991; R 1998) Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/cu. ft. (2,700 kN-m/cu. m.))
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2487	(1998) Classification of Soils for Engineering Purposes (Unified Soil Classification System)
ASTM D 2922	(1996el) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 3017	(1988; R 1996el) Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth)
ASTM D 4318	(1998) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM E 11	(1995) Wire-Cloth Sieves for Testing Purposes

1.2 DEFINITIONS

For the purposes of this specification, the following definitions apply.

1.2.1 Aggregate Base Course

Aggregate base course (ABC) is well graded, durable aggregate uniformly moistened and mechanically stabilized by compaction.

1.2.3 Degree of Compaction

Degree of compaction shall be expressed as a percentage of the maximum density obtained by the test procedure presented in ASTM D 1557.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Plant, Equipment, and Tools

SD-06 Test Reports

Sampling and testing; G, RE
Field Density Tests

Calibration curves and related test results prior to using the device or equipment being calibrated. Copies of field test results within 24 hours after the tests are performed. Certified copies of test results for approval not less than 30 days before material is required for the work.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed in conformance with the applicable standards listed.

1.5.2.1 Sieve Analysis

Sieve analysis shall be made in conformance with ASTM C 117 and ASTM C 136. Sieves shall conform to ASTM E 11.

1.5.2.2 Liquid Limit and Plasticity Index

Liquid limit and plasticity index shall be determined in accordance with ASTM D 4318.

1.5.2.3 Moisture-Density Determinations

The maximum density and optimum moisture content shall be determined in accordance with ASTM D 1557.

1.5.2.4 Field Density Tests

Density shall be field measured in accordance with ASTM D 1556 or ASTM D 2922. For the method presented in ASTM D 1556 the base plate as shown in the drawing shall be used. For the method presented in ASTM D 2922 the calibration curves shall be checked and adjusted if necessary using only the sand cone method as described in paragraph Calibration, of the ASTM publication. Tests performed in accordance with ASTM D 2922 result in a wet unit weight of soil and when using this method, ASTM D 3017 shall be used to determine the moisture content of the soil. The calibration curves furnished with the moisture gauges shall also be checked along with density calibration checks as described in ASTM D 3017. The calibration checks of both the density and moisture gauges shall be made by the prepared containers of material method, as described in paragraph Calibration of ASTM D

2922, on each different type of material being tested at the beginning of a job and at intervals as directed.

1.5.2.5 Wear Test

Wear tests shall be made on ABC course material in conformance with ASTM C 131.

1.5.3 Testing Frequency

1.5.3.1 Initial Tests

One of each of the following tests shall be performed on the proposed material prior to commencing construction to demonstrate that the proposed material meets all specified requirements when furnished. If materials from more than one source are going to be utilized, this testing shall be completed for each source.

- a. Sieve Analysis including 0.02 mm.
- b. Liquid limit and plasticity index moisture-density relationship.
- c. Moisture-density relationship.
- d. Wear.

1.5.3.2 In Place Tests

One of each of the following tests shall be performed on samples taken from the placed and compacted ABC. Samples shall be taken and tested at the rates indicated.

- a. Density tests shall be performed on every lift of material placed and at a frequency of one set of tests for every 250 square meters , or portion thereof, of completed area.
- b. Sieve Analysis including 0.02 mm size material shall be performed for every 500 metric tons, or portion thereof, of material placed.
- c. Liquid limit and plasticity index tests shall be performed at the same frequency as the sieve analysis.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.6 WEATHER LIMITATIONS

Construction shall be done when the atmospheric temperature is above 2 degrees C. When the temperature falls below 2 degrees C, , the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by

freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

PART 2 PRODUCTS

The ABC shall consist of clean, sound, durable particles of crushed stone, crushed slag, crushed gravel, crushed recycled concrete, angular sand, or other approved material. ABC shall be free of lumps of clay, organic matter, and other objectionable materials or coatings. The portion retained on the 4.75 mm sieve shall be known as coarse aggregate; that portion passing the 4.75 mm sieve shall be known as fine aggregate.

2.1.1 Coarse Aggregate

Coarse aggregates shall be angular particles of uniform density. When the coarse aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements and shall be stockpiled separately.

a. Crushed Gravel: Crushed gravel shall be manufactured by crushing gravels, and shall meet all the requirements specified below.

b. Crushed Stone: Crushed stone shall consist of freshly mined quarry rock, and shall meet all the requirements specified below.

c. Crushed Recycled Concrete: Crushed recycled concrete shall consist of previously hardened portland cement concrete or other concrete containing pozzolanic binder material. The recycled material shall be free of all reinforcing steel, bituminous concrete surfacing, and any other foreign material and shall be crushed and processed to meet the required gradations for coarse aggregate. Crushed recycled concrete shall meet all other applicable requirements specified below.

d. Crushed Slag: Crushed slag shall be an air-cooled blast-furnace product having an air dry unit weight of not less than 1045 kg/cubic meter as determined by ASTM C 29/C 29M, and shall meet all the requirements specified below.

2.1.1.1 Aggregate Base Course

ABC coarse aggregate shall not show more than 50 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C 131. The amount of flat and elongated particles shall not exceed 30 percent. A flat particle is one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3. In the portion retained on each sieve specified, the crushed aggregates shall contain at least 50 percent by weight of crushed pieces having two or more freshly fractured faces with the area of each face being at least equal to 75 percent of the smallest midsectional area of the piece.

When two fractures are contiguous, the angle between planes of the fractures must be at least 30 degrees in order to count as two fractured faces. Crushed gravel shall be manufactured from gravel particles 50 percent of which, by weight, are retained on the maximum size sieve listed in TABLE 1.

2.1.2 Fine Aggregate

Fine aggregates shall be angular particles of uniform density. When the fine aggregate is supplied from more than one source, aggregate from each source shall meet the specified requirements.

2.1.2.1 Aggregate Base Course

ABC fine aggregate shall consist of screenings, angular sand, crushed recycled concrete fines, or other finely divided mineral matter processed or naturally combined with the coarse aggregate.

2.1.3 Gradation Requirements

The specified gradation requirements shall apply to the completed base course. The aggregates shall have a maximum size of 25 mm and shall be continuously well graded within the limits specified in TABLE 1. Sieves shall conform to ASTM E 11.

TABLE 1. GRADATION OF AGGREGATES

Percentage by Weight Passing Square-Mesh Sieve

Sieve Designation	
50.0 mm	----
37.5 mm	----
25.0 mm	100
12.5 mm	40-70
4.75 mm	20-50
2.00 mm	15-40
0.425 mm	5-25
0.075 mm	0-10

NOTE 1: Particles having diameters less than 0.02 mm shall not be in excess of 3 percent by weight of the total sample tested.

NOTE 2: The values are based on aggregates of uniform specific gravity. If materials from different sources are used for the coarse and fine aggregates, they shall be tested in accordance with ASTM C 127 and ASTM C 128 to determine their specific gravities. If the specific gravities vary by more than 10 percent, the percentages passing the various sieves shall be corrected as directed by the Contracting Officer.

2.1.4 Liquid Limit and Plasticity Index

Liquid limit and plasticity index requirements shall apply to the completed course and shall also apply to any component that is blended to meet the required gradation. The portion of any component or of the completed course passing the 0.425 mm sieve shall be either nonplastic or have a liquid limit not greater than 25 and a plasticity index not greater than 5.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

When the ABC is constructed in more than one layer, the previously constructed layer shall be cleaned of loose and foreign matter by sweeping with power sweepers or power brooms, except that hand brooms may be used in areas where power cleaning is not practicable. Adequate drainage shall be provided during the entire period of construction to prevent water from collecting or standing on the working area. Line and grade stakes shall be provided as necessary for control. Grade stakes shall be in lines parallel to the centerline of the area under construction and suitably spaced for string lining.

3.2 OPERATION OF AGGREGATE SOURCES

Aggregates shall be obtained from offsite sources.

3.4 PREPARATION OF UNDERLYING COURSE

Prior to constructing the ABC, the underlying course or subgrade shall be cleaned of all foreign substances. At the time of construction of the ABC, the underlying course shall contain no frozen material. The surface of the underlying course or subgrade shall meet specified compaction and surface tolerances. The underlying course shall conform to Section 02300 EARTHWORK. Ruts or soft yielding spots in the underlying courses, areas having inadequate compaction, and deviations of the surface from the requirements set forth herein shall be corrected by loosening and removing soft or unsatisfactory material and by adding approved material, reshaping to line and grade, and recompact to specified density requirements. For cohesionless underlying courses containing sands or gravels, as defined in ASTM D 2487, the surface shall be stabilized prior to placement of the ABC. Stabilization shall be accomplished by mixing ABC into the underlying course and compacting by approved methods. The stabilized material shall be considered as part of the underlying course and shall meet all requirements of the underlying course. The finished underlying course shall not be disturbed by traffic or other operations and shall be maintained by the Contractor in a satisfactory condition until the ABC is placed.

3.5 INSTALLATION

3.5.1 Mixing the Materials

The coarse and fine aggregates shall be mixed in a stationary plant, or in a traveling plant or bucket loader on an approved paved working area. The Contractor shall make adjustments in mixing procedures or in equipment as directed to obtain true grades, to minimize segregation or degradation, to obtain the required water content, and to insure a satisfactory ABC meeting all requirements of this specification.

3.5.2 Placing

The mixed material shall be placed on the prepared subgrade or subbase in layers of uniform thickness with an approved spreader. When a compacted layer 150 mm or less in thickness is required, the material shall be placed in a single layer. When a compacted layer in excess of 150 mm is required, the material shall be placed in layers of equal thickness. No layer shall exceed 150 mm or less than 75mm when compacted. The layers shall be so placed that when compacted they will be true to the grades or levels required with the least possible surface disturbance. Where the ABC is placed in more than one layer, the previously constructed layers shall be cleaned of loose and foreign matter by sweeping with power sweepers, power brooms, or hand brooms, as directed. Such adjustments in placing procedures or equipment shall be made as may be directed to obtain true grades, to minimize segregation and degradation, to adjust the water content, and to insure an acceptable ABC.

3.5.3 Grade Control

The finished and completed ABC shall conform to the lines, grades, and cross sections shown. Underlying material(s) shall be excavated and prepared at sufficient depth for the required ABC thickness so that the finished ABC with the subsequent surface course will meet the designated grades.

3.5.4 Edges of Base Course

The ABC shall be placed so that the completed section will be a minimum of 1.5 m wider, on all sides, than the next layer that will be placed above it. Additionally, approved fill material shall be placed along the outer edges of ABC in sufficient quantities to compact to the thickness of the course being constructed, or to the thickness of each layer in a multiple layer course, allowing in each operation at least a 600 mm width of this material to be rolled and compacted simultaneously with rolling and compacting of each layer of ABC. If this base course material is to be placed adjacent to another pavement section, then the layers for both of these sections shall be placed and compacted along this edge at the same time.

3.5.5 Compaction

Each layer of the ABC shall be compacted as specified with approved compaction equipment. Water content shall be maintained during the compaction procedure to within plus or minus 2 percent of the optimum water content determined from laboratory tests as specified in paragraph SAMPLING AND TESTING. Rolling shall begin at the outside edge of the surface and proceed to the center, overlapping on successive trips at least one-half the width of the roller. Alternate trips of the roller shall be slightly different lengths. Speed of the roller shall be such that displacement of the aggregate does not occur. In all places not accessible to the rollers, the mixture shall be compacted with hand-operated power tampers. Compaction shall continue until each layer has a degree of compaction that is at least 100 percent of laboratory maximum density through the full depth of the layer. The Contractor shall make such adjustments in compacting or finishing procedures as may be directed to obtain true grades, to minimize segregation and degradation, to reduce or increase water content, and to ensure a satisfactory ABC. Any materials that are found to be unsatisfactory shall be removed and replaced with satisfactory material or reworked, as directed, to meet the requirements of this specification.

3.5.6 Thickness

Compacted thickness of the aggregate course shall be as indicated. No individual layer shall exceed 200 mm nor be less than 75 mm in compacted thickness. The total compacted thickness of the ABC course shall be within 7 mm of the thickness indicated. Where the measured thickness is more than 7 mm deficient, such areas shall be corrected by scarifying, adding new material of proper gradation, reblading, and recompact as directed. Where the measured thickness is more than 7 mm thicker than indicated, the course shall be considered as conforming to the specified thickness requirements. Average job thickness shall be the average of all thickness measurements taken for the job, but shall be within 6 mm of the thickness indicated. The total thickness of the ABC course shall be measured at intervals in such a manner as to ensure one measurement for each 500 square meters of base course. Measurements shall be made in 75 mm diameter test holes penetrating the base course.

3.5.8 Finishing

The surface of the top layer of ABC shall be finished after final compaction by cutting any overbuild to grade and rolling with a steel-wheeled roller. Thin layers of material shall not be added to the top layer of base course to meet grade. If the elevation of the top layer of ABC is 13 mm or more below grade, then the top layer should be scarified to a depth of at least 75 mm and new material shall be blended in and compacted to bring to grade. Adjustments to rolling and finishing procedures shall be made as directed to minimize segregation and degradation, obtain grades, maintain moisture content, and insure an acceptable base course. Should the surface become rough, corrugated, uneven in texture, or traffic marked prior to completion, the unsatisfactory portion shall be scarified, reworked and recompact or it shall be replaced as directed.

3.5.9 Smoothness

The surface of the top layer shall show no deviations in excess of 10 mm when tested with a 3.66 meter straightedge. Measurements shall be taken in successive positions parallel to the centerline of the area to be paved. Measurements shall also be taken perpendicular to the centerline at 15 meter intervals. Deviations exceeding this amount shall be corrected by removing material and replacing with new material, or by reworking existing material and compacting it to meet these specifications.

3.6 TRAFFIC

Completed portions of the ABC course may be opened to limited traffic, provided there is no marring or distorting of the surface by the traffic. Heavy equipment shall not be permitted except when necessary to construction, and then the area shall be protected against marring or damage to the completed work.

3.7 MAINTENANCE

The ABC shall be maintained in a satisfactory condition until the full pavement section is completed and accepted. Maintenance shall include immediate repairs to any defects and shall be repeated as often as necessary to keep the area intact. Any ABC that is not paved over prior to the onset of winter, shall be retested to verify that it still complies with the

requirements of this specification. Any area of ABC that is damaged shall be reworked or replaced as necessary to comply with this specification.

3.8 DISPOSAL OF UNSATISFACTORY MATERIALS

Any unsuitable materials that must be removed shall be disposed of off-site, or as directed. No additional payments will be made for materials that must be replaced.

END OF SECTION

SECTION 02726

PORTLAND CEMENT PERVIOUS PAVEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 180	(1997) Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457 mm (18-in) Drop
AASHTO T 224	(1996) Correction for Coarse Particles in the Soil Compaction Test

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 33	(1999a) Concrete Aggregates
ASTM C 42	(1999) Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 117	(1995) Materials Finer Than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 150	(1999a) Portland Cement
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM D 448	(1998) Standard Sizes of Coarse Aggregate for Highway Construction
ASTM E 329	(2002) Practice for Inspection and Testing Agencies for Concrete, Steel, and Bituminous Materials as Used in Construction

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment

- a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.
- b. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment at least 7 days prior to start of paving unless otherwise specified.
- c. At the time the materials are furnished for the mixture proportioning study, a description of the equipment proposed for the placing of the concrete mixture, method of control, and manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement, free of tears and other surface imperfections, including excessive paste on the surface. The literature shall show that the equipment meets all details of these specifications.

Proposed Techniques; G

- a. A description of the placing and protection methods proposed prior to construction of the test section, if concrete is to be placed in or exposed to hot or cold weather conditions.
- b. A detailed plan of the proposed paving pattern showing all planned construction joints. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the Seattle District, Design Branch, Civil/Soils Section.
- c. Data on the curing media and methods to be used.

Samples for Mixture Proportioning Studies; G

The results of the Contractor's mixture proportioning studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of concrete at least 30 days prior to commencing concrete placing operations. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, inspected by the Government, and approved in writing, showing that mixture proportioning studies have been made with materials proposed for the project and

that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture proportions without additional tests to show that the quality of the concrete is satisfactory.

SD-06 Test Reports

Sampling and Testing; G

Certified copies of laboratory test reports, including all test data, for cement, pozzolan, aggregate, admixtures, and curing compound proposed for use on this project. These tests shall be made by an approved independent commercial testing laboratory or by a laboratory maintained by the manufacturers of the materials. No material shall be used until notice of acceptance has been given. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site.

SD-0X Contractor Qualifications

Qualifications; G

The use of an ACI Concrete Flatwork Certified Finisher is required. Prior to award of the contract, the placing contractor shall furnish the Contracting Officer a statement attesting to the following qualifications and experience:

A minimum of 2 successfully completed projects with addresses, including each project's unit weight acceptance data, in-situ pavement test results including void content and unit weight, and sample of product (i.e. core of test panel).

If the placing Contractor and concrete producer have insufficient experience with portland cement pervious concrete pavement, the placing Contractor shall retain an experienced consultant (as qualified above) to monitor production, handling, and placement operations at the Contractor's expense.

1.5 SAMPLING AND TESTING

Sampling and testing shall be the responsibility of the Contractor. Sampling and testing shall be performed by a testing laboratory approved in accordance with Section 01451 CONTRACTOR QUALITY CONTROL. Work requiring testing will not be permitted until the testing laboratory has been inspected and approved. The materials shall be tested to establish compliance with the specified requirements; testing shall be performed at the specified frequency. The Contracting Officer may specify the time and location of the tests. Copies of test results shall be furnished to the Contracting Officer within 24 hours of completion of the tests.

1.5.1 Sampling

Samples for laboratory testing shall be taken in conformance with ASTM D 75. When deemed necessary, the sampling will be observed by the Contracting Officer.

1.5.2 Tests

The following tests shall be performed, in conformance with the applicable standards listed, as indicated in paragraph: PORTLAND CEMENT PERVIOUS PAVEMENT CONCRETE TESTING INSPECTION AND ACCEPTANCE.

1.5.4 Approval of Material

The source of the material shall be selected 30 days prior to the time the material will be required in the work. Tentative approval of material will be based on initial test results. Final approval of the materials will be based on sieve analysis, liquid limit, and plasticity index tests performed on samples taken from the completed and fully compacted ABC.

1.6 WEATHER LIMITATIONS

Portland cement pervious pavement construction shall be done when the atmospheric temperature is between 40 degrees F and 80 degrees F, unless specifically approved by the Contracting Officer. When the temperature falls below 40 degrees F, the Contractor shall protect all completed areas by approved methods against detrimental effects of freezing. Completed areas damaged by freezing, rainfall, or other weather conditions shall be corrected to meet specified requirements.

1.7 PLANT, EQUIPMENT, AND TOOLS

All plant, equipment, and tools used in the performance of the work will be subject to approval before the work is started and shall be maintained in satisfactory working condition at all times. The equipment shall be adequate and shall have the capability of producing the required compaction, meeting grade controls, thickness control, and smoothness requirements as set forth herein.

1.8 TEST PANEL

The Contractor shall place, joint and cure two test panels, each to be a minimum of 225 sq. ft. at the required project thickness to demonstrate, to the satisfaction of the Contracting Officer, that in-place unit weights can be achieved and a satisfactory pavement can be installed at the site location.

1.8.1 Test Panel Location

Test panels may be placed at any of the specified portland cement pervious pavement locations.

1.8.2 Test Panel Testing Requirements and Tolerances

Test panels shall be tested for the following:

Thickness: Thickness shall be accordance with ASTM C 42; Compacted thickness no less than 1/4-inch of specified thickness.

Void Structure: Void Structure shall be tested in accordance with ASTM C 138; 12% minimum to 21% maximum.

Core Unit Weight: The core unit weight shall be in accordance with ASTM C 140, paragraph 6.3, and shall be within plus or minus 5 pcf of the design unit weight.

1.8.3 Test Panel Acceptance

If measured void structure falls below 15%, if measured thickness is greater than 1/4" less than the specified thickness or measured weight falls less than 5 pcf below unit weight, the test panel shall be rejected and removed and disposed of at the Contractor's expense. If the test panel meets the above-mentioned requirements, it can be left in-place and included in the completed work.

PART 2 PRODUCTS

2.1 CONCRETE MIX DESIGN

Contractor shall furnish a proposed mix design with proportions of materials to the Contracting Officer 30 days prior to commencement of work. The data shall include rodded unit weights determined in accordance with ASTM C 29 Paragraph 11, Rodded Unit Weight.

2.1.1 Proportions

2.1.1.1 Aggregate and Cement Content

The volume of aggregate, cement, water, and admixture per cu. yd. shall be equal to 27 cu. ft. when calculated as a function of the unit weight determined in accordance with ASTM C 29 rodding procedure. Fine aggregate, if used, should not exceed 3 cu. ft. and shall be included in the total aggregate volume.

2.1.1.2 Admixtures

Shall be used in accordance with the manufacturer's instructions and recommendations.

2.1.1.3 Mix Water

Mix water shall be such that the cement paste displays a wet metallic sheen without causing the paste to flow from the aggregate. (Mix water yielding a cement paste with a dull-dry appearance has insufficient water for hydration).

2.1.1.4 Water Cement Ratio

Water cement ratio shall range from 0.27 to 0.35.

- a. Insufficient water results in inconsistency in the mix and poor bond strength.
- b. High water content results in the paste sealing the void system primarily at the bottom and poor surface bond.

2.2 MATERIALS

Locally available material having a record of satisfactory performance shall be used.

2.3 PORTLAND CEMENT PERVIOUS CONCRETE

2.3.1 Cement

Portland Cement Type I or II conforming to ASTM C 150 or Portland Cement Type IP or IS conforming to ASTM C 595.

2.3.2 Aggregate

Aggregate for Portland cement pervious concrete shall be crushed gravel, stone or hydraulic cement concrete or combination there of meeting No 8 coarse aggregate (3/8 to No. 16) per ASTM C 33 or No. 89 coarse aggregate (3/8 to No. 50) per ASTM D 448. If other gradation of aggregate is to be used, submit data on proposed material to owner for approval.

2.3.3 Admixtures

The following admixtures shall be used:

2.3.3.1 Water Reducing/Retarding Admixture

Water reducing/retarding shall be in conformance with ASTM C 494, Type D.

2.3.3.2 Hydration Stabilizer

A hydration stabilizer that also meets the requirements of ASTM C 494, Type B Retarding or Type D Water Reducing/Retarding admixtures. This stabilizer suspends cement hydration by forming a protective barrier around the cementitious particles, which delays the particles from achieving initial set.

2.3.4 Water

Potable water shall be used.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

- a. Existing subgrade under bed areas shall NOT be compacted or subject to excessive construction equipment traffic prior to filter fabric and stone bed placement.
- b. Where erosion of subgrade has caused accumulation of fine materials and/or surface ponding, this material shall be removed with light equipment and the underlying soils scarified to a minimum depth of 6 inches with a York rake or equivalent and light tractor.
- c. Bring subgrade of stone recharge bed to line, grade, and elevations indicated. Fill and lightly regrade any areas damaged by erosion, ponding, or traffic compaction before the placing of stone.

3.2 RECHARGE BED INSTALLATION

- a. Upon completion of subgrade work, the Engineer shall be notified and shall inspect at his discretion before proceeding with recharge bed installation.
- b. Filter fabric, pipe, and recharge bed aggregate shall be placed immediately after approval of subgrade preparation. Any accumulation of debris or sediment which has taken place after approval of subgrade shall be removed prior to installation of filter fabric at no extra cost to the Owner.
- c. Place filter fabric in accordance with manufacturer's standards and recommendations. Adjacent strips of filter fabric shall overlap a minimum of sixteen inches (16"). Secure fabric at least two feet (2') outside of bed and take steps necessary to prevent any runoff or sediment from entering the storage bed. Place impervious liner over geo-textile extending 6' beyond toe of slope face at building face, secure as recommended by manufacturer.
- d. Install coarse aggregate in 8-inch maximum lifts. Lightly compact each layer with equipment, keeping equipment movement over storage bed subgrades to a minimum. Install aggregate to grades indicated on the drawings.
- e. Install 1" thick choker base course size No. 57 (AASHTO) aggregate evenly over surface of stone bed, sufficient to allow placement of pavement, and notify Engineer for approval.
- f. Following placement of bed aggregate, the filter fabric shall be folded back along all bed edges to protect from sediment washout along bed edges. At least a two foot edge strip shall be used to protect beds from adjacent bare soil. This edge strip shall remain in place until all bare soils contiguous to beds are stabilized and vegetated. In addition, hay bales shall be placed at the toe of slopes which may be adjacent to beds to further prevent sediment from washing into beds during site development. As the site is fully stabilized, excess filter fabric along bed edges can be cut back to gravel edge.

3.3 PORTLAND CEMENT PERVIOUS PAVEMENT CONCRETE MIXING, HAULING AND PLACING

3.3.1 Mix Time

Truck mixers shall be operated at the speed designated as mixing speed by the manufacturer for 75 to 100 revolutions of the drum.

3.3.2 Transportation

The portland cement pervious pavement aggregate mixture may be transported or mixed on site and should be used within one (1) hour of the introduction of mix water, unless otherwise approved by an engineer. This time can be increased to 90 minutes when utilizing the hydration stabilizer specified as long as the temperature of the concrete does not exceed 90 degrees Fahrenheit. Under no circumstance will retempering of concrete be allowed after any water adjustments have been made to delivered concrete at jobsite.

3.3.3 Base Course

Prior to placing concrete, the base course material shall be moistened and in a wet condition.

3.3.4 Discharge

Each mixer truck will be inspected for appearance of concrete uniformity. Water may be added to obtain the required mix consistency. Any water adjustments made at the jobsite shall be made by the Contractor's Quality Control representatives, only upon approval by the on-site Contracting Officer's Representative. A minimum of 20 revolutions at the manufacturer's designated mixing speed shall be required following any addition of water to the mix. Discharge shall be a continuous operation and shall be completed as quickly as possible. Concrete shall be deposited as close to its final position as practicable and such that fresh concrete enters the mass of previously placed concrete. The practice of discharging onto subgrade and pulling or shoveling to final placement is not allowed.

3.3.5 Placing and Finishing Equipment

The Contractor shall provide mechanical equipment of either slipform or form riding with a following compactive unit that will provide a minimum of 10 psi vertical force, unless otherwise approved by the Contracting Officer in writing. The pervious concrete pavement will be placed to the required cross section and shall not deviate more than +/- 3/8-inch in 10 feet from profile grade. If placing equipment does not provide the minimum specified vertical force, a full width roller or other full width compaction device that provides sufficient compactive effort shall be used immediately following the strike-off operation. After mechanical or other approved strike-off and compaction operation, no other finishing operation will be allowed. If vibration, internal or surface applied, is used, it shall be shut off immediately when forward progress is halted for any reason. The Contractor will be restricted to pavement placement widths of a maximum of fifteen (15-ft) feet unless the Contractor can demonstrate competence to provide pavement placement widths greater than the maximum specified to the satisfaction of the Engineer.

3.3.6 Curing

Curing procedures shall begin within 20 minutes after the final placement operations. The pavement surface shall be covered with a minimum six (6) mil thick polyethylene sheet or other approved covering material. Prior to covering, a fog or light mist shall be sprayed above the surface when required due to ambient conditions (high temperature, high wind, and low humidity). The cover shall overlap all exposed edges and shall be secured (without using dirt or stone) to prevent dislocation due to winds or adjacent traffic conditions.

3.3.6.1 Cure Time

Portland Cement Type I, II: 7 days minimum. No truck traffic shall be allowed for 10 days (no passenger car/light trucks for 7 days).

3.3.7 Jointing

Control (contraction) joints shall be installed as indicated by landscape architect plans. They shall be installed at a depth of 1/4 the thickness of the pavement. These joints can be installed in the plastic concrete or saw cut. If saw cut, the procedure should begin as soon as

the pavement has hardened sufficiently to prevent raveling and uncontrolled cracking (normally after curing). Transverse construction joints shall be installed whenever placing is suspended a sufficient length of time that concrete may begin to harden. In order to assure aggregate bond at construction joints, a bonding agent suitable for bonding fresh concrete shall be brushed, rolled, or sprayed on the existing pavement surface edge. Isolation (expansion) joints will not be used except when pavement is abutting slabs or other adjoining structures.

3.4 PORTLAND CEMENT PERVIOUS PAVEMENT CONCRETE TESTING, INSPECTION, AND ACCEPTANCE

3.4.1 Laboratory Testing

Testing will be conducted by an approved independent commercial testing laboratory.

3.4.2 Testing and Acceptance

3.4.2.1 Unit Weight

A minimum of one test for each day's placement of pervious concrete in accordance with ASTM C 172 and ASTM C 29 to verify unit weight shall be conducted. Delivered unit weights are to be determined in accordance with ASTM C 29 using a 0.25 cubic foot cylindrical metal measure. The measure is to be filled and compacted in accordance with ASTM C 29 paragraph 11, rodding procedure. The unit weight of the delivered concrete shall be +/- 5 pcf of the design unit weight.

3.4.2.2 Cores

The paving contractor shall provide two cores taken from each panel in accordance with ASTM C 42 at a minimum of seven (7) days after placement of the pervious concrete. The cores shall be measured for thickness, void structure, and unit weight. Untrimmed, hardened core samples shall be used to determine placement thickness. The average of all production cores shall not be less than the specified thickness with no individual core being more than 1/2-inch less than the specified thickness. After thickness determination, the cores shall be trimmed and measured for unit weight per ASTM C 642. Ranges of satisfactory unit weight values are +/- 5 pcf of the design unit weight. Core holes shall be filled with concrete meeting the pervious mix design per ASTM C 642.

END OF SECTION

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SECTION 02741

HOT-MIX ASPHALT (HMA) FOR ROADS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO MP 1	(1998) Provisional Specification for Performance Graded Asphalt Binder
AASHTO MP 2	(1998; Interim 1999) Superpave Volumetric Mix Design
AASHTO TP53	(1998; Interim 1999) Determining Asphalt Content of Hot Mix Asphalt by the Ignition Method

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregates
ASTM C 88	(1999a) Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	(1995) Materials Finer than 75 micrometer (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 566	(1997) Evaporable Total Moisture Content of Aggregate by Drying
ASTM C 1252	(1998) Uncompacted Void Content of Fine Aggregate (as Influenced by Particle Shape, Surface Texture, and Grading)
ASTM D 140	(1998) Sampling Bituminous Materials
ASTM D 242	(1995) Mineral Filler for Bituminous Paving Mixtures

ASTM D 946	(1999) Penetration-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 995	(1995b) Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures
ASTM D 1461	(1985)) Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	(1989) Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	(1995) Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	(1995) Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	(1995) Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	(1984; R 1994el) Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	(1996el) Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixture
ASTM D 2950	(1997) Density of Bituminous Concrete in Place by Nuclear Method
ASTM D 3381	(1999) Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3665	(1999) Random Sampling of Construction Materials
ASTM D 3666	(1998) Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	(1994el) Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4791	(1999) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867/D 4867M	(1996) Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM D 5444	(1998) Mechanical Size Analysis of Extracted Aggregate

ASTM D 6307 (1998) Asphalt Content of Hot Mix Asphalt by Ignition Method

ASPHALT INSTITUTE (AI)

AI MS-2 (1997) Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types

AI MS-22 (1998; 2nd Edition) Construction of Hot-Mix Asphalt Pavements

CALIFORNIA DEPARTMENT OF TRANSPORTATION (CDT)

CDT Test 526 (1978) Operation of California Profilograph and Evaluation of Profiles

CORPS OF ENGINEERS (COE)

COE CRD-C 171 (1995) Test Method for Determining Percentage of Crushed Particles in Aggregate

1.2 DESCRIPTION OF WORK

The work shall consist of pavement courses composed of mineral aggregate and asphalt material heated and mixed in a central mixing plant and placed on a prepared course. HMA designed and constructed in accordance with this section shall conform to the lines, grades, thicknesses, and typical cross sections shown on the drawings. Each course shall be constructed to the depth, section, or elevation required by the drawings and shall be rolled, finished, and approved before the placement of the next course.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mix Design; G,RE.

Proposed JMF.

Contractor Quality Control; G; RE.

Quality control plan.

Material Acceptance; G, RE.

Acceptance test results.

SD-04 Samples

Asphalt Cement Binder.

20 L sample for mix design verification.

Aggregates.

Sufficient materials to produce 90 kg of blended mixture for mix design verification.

SD-06 Test Reports

Aggregates; G, RE.

QC Monitoring; G, RE.

Aggregate and QC test results.

SD-07 Certificates

Asphalt Cement Binder; G, RE.

Copies of certified test data.

Testing Laboratory; G, RE.

Certification of compliance.

Plant Scale Calibration Certification

1.6 ASPHALT MIXING PLANT

Plants used for the preparation of hot-mix asphalt shall conform to the requirements of ASTM D 995 with the following changes:

a. Truck Scales. The asphalt mixture shall be weighed on approved certified scales at the Contractor's expense. Scales shall be inspected and sealed at least annually by an approved calibration laboratory.

b. Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Government's acceptance testing and the Contractor's quality control testing.

c. Inspection of Plant. The Contracting Officer shall have access at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant; verifying weights, proportions, and material properties; checking the temperatures maintained in the preparation of the mixtures and for taking samples. The Contractor shall provide assistance as requested, for the Government to procure any desired samples.

d. Storage Bins. Use of storage bins for temporary storage of hot-mix asphalt will be permitted as follows:

(1) The asphalt mixture may be stored in non-insulated storage bins for a period of time not exceeding 3 hours.

(2) The asphalt mixture may be stored in insulated storage bins for a period of time not exceeding 8 hours. The mix drawn from bins shall meet the same requirements as mix loaded directly into trucks.

1.7 HAULING EQUIPMENT

Trucks used for hauling hot-mix asphalt shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum based products shall not be used as a release agent. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers (tarps) shall be securely fastened.

1.8 ASPHALT PAVERS

Asphalt pavers shall be self-propelled, with an activated screed, heated as necessary, and shall be capable of spreading and finishing courses of hot-mix asphalt which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

1.8.1 Receiving Hopper

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

1.8.2 Automatic Grade Controls

If an automatic grade control device is used, the paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent. A transverse slope controller shall not be used to control grade. The controls shall be capable of working in conjunction with any of the following attachments:

- a. Ski-type device of not less than 9.14 m in length.
- b. Taut stringline set to grade.
- c. Short ski or shoe for joint matching.
- d. Laser control.

1.9 ROLLERS

Rollers shall be in good condition and shall be operated at slow speeds to avoid displacement of the asphalt mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition. Equipment which causes excessive crushing of the aggregate shall not be used.

1.10 WEATHER LIMITATIONS

The hot-mix asphalt shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 1. The temperature requirements may be waived by the Contracting Officer, if requested; however, all other requirements, including compaction, shall be met.

Table 1. Surface Temperature Limitations of Underlying Course

<u>Mat Thickness, mm</u>	<u>Degrees C</u>
75 or greater	4
Less than 75	7

PART 2 PRODUCTS

2.1 AGGREGATES

Aggregates shall consist of crushed stone, crushed gravel, crushed slag, screenings, natural sand and mineral filler, as required. The portion of material retained on the 4.75 mm sieve is coarse aggregate. The portion of material passing the 4.75 mm sieve and retained on the 0.075 mm sieve is fine aggregate. The portion passing the 0.075 mm sieve is defined as mineral filler. All aggregate test results and samples shall be submitted to the Contracting Officer at least 14 days prior to start of construction.

2.1.1 Coarse Aggregate

Coarse aggregate shall consist of sound, tough, durable particles, free from films of material that would prevent thorough coating and bonding with the asphalt material and free from organic matter and other deleterious substances. All individual coarse aggregate sources shall meet the following requirements:

- a. The percentage of loss shall not be greater than 40 percent after 500 revolutions when tested in accordance with ASTM C 131.
- b. The percentage of loss shall not be greater than 18 percent after five cycles when tested in accordance with ASTM C 88 using magnesium sulfate [or 12 percent when using sodium sulfate].
- c. At least 75 percent by weight of coarse aggregate shall have at least two or more fractured faces when tested in accordance with COE CRD-C 171. Fractured faces shall be produced by crushing.

d. The particle shape shall be essentially cubical and the aggregate shall not contain more than 20% percent, by weight, of flat and elongated particles (3:1 ratio of maximum to minimum) when tested in accordance with ASTM D 4791.

e. Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 1200 kg/cubic meter when tested in accordance with ASTM C 29/C 29M.

2.1.2 Fine Aggregate

Fine aggregate shall consist of clean, sound, tough, durable particles. The aggregate particles shall be free from coatings of clay, silt, or any objectionable material and shall contain no clay balls. All individual fine aggregate sources shall have a sand equivalent value not less than 45 when tested in accordance with ASTM D 2419.

The fine aggregate portion of the blended aggregate shall have an uncompacted void content not less than 43.0 percent when tested in accordance with ASTM C 1252 Method A.

2.1.3 Mineral Filler

Mineral filler shall be nonplastic material meeting the requirements of ASTM D 242.

2.1.4 Aggregate Gradation

The combined aggregate gradation shall conform to gradations specified in Table 2, when tested in accordance with ASTM C 136 and ASTM C 117, and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve or vice versa, but grade uniformly from coarse to fine.

Table 2. Aggregate Gradations

<u>Sieve Size, mm</u>	<u>Gradation 1</u>	<u>Gradation 2</u>
	<u>Percent Passing</u> <u>by Mass</u>	<u>Percent Passing</u> <u>by Mass</u>
25.0	---	---
19.0	100	---
12.5	76-96	100
9.5	69-89	76-96
4.75	53-73	58-78
2.36	38-60	40-60
1.18	26-48	28-48
0.60	18-38	18-38
0.30	11-27	11-27
0.15	6-18	6-18
0.075	3-6	3-6

2.2 ASPHALT CEMENT BINDER

Asphalt cement binder shall conform to ASTM D 3381 Table 2, Viscosity Grade, AR-4000W. Test data indicating grade certification shall be provided by the supplier at the time of delivery

of each load to the mix plant. Copies of these certifications shall be submitted to the Contracting Officer. The supplier is defined as the last source of any modification to the binder. The Contracting Officer may sample and test the binder at the mix plant at any time before or during mix production. Samples for this verification testing shall be obtained by the Contractor in accordance with ASTM D 140 and in the presence of the Contracting Officer. These samples shall be furnished to the Contracting Officer for the verification testing, which shall be at no cost to the Contractor. Samples of the asphalt cement specified shall be submitted for approval not less than 14 days before start of the test section.

2.3 MIX DESIGN

The Contractor shall develop the mix design. The asphalt mix shall be composed of a mixture of well-graded aggregate, mineral filler if required, and asphalt material. The aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF). No hot-mix asphalt for payment shall be produced until a JMF has been approved. The hot-mix asphalt shall be designed using procedures contained in AI MS-2 and the criteria shown in Table 3. If the Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867/D 4867M is less than 75, the aggregates shall be rejected or the asphalt mixture treated with an approved anti-stripping agent. The amount of anti-stripping agent added shall be sufficient to produce a TSR of not less than 75. If an antistrip agent is required, it shall be provided by the Contractor at no additional cost. Sufficient materials to produce 90 kg of blended mixture shall be provided to the Contracting Officer for verification of mix design at least 14 days prior to construction of test section.

At the option of the contractor a currently used DOT superpave hot mix may be used in lieu of developing a new hot mix design study as described herein. The superpave volumetric mix shall be designed in accordance with AASHTO MP 2.

2.3.1 JMF Requirements

The job mix formula shall be submitted in writing by the Contractor for approval at least 14 days prior to the start of the test section and shall include as a minimum:

- a. Percent passing each sieve size.
- b. Percent of asphalt cement.
- c. Percent of each aggregate and mineral filler to be used.
- d. Asphalt viscosity grade, penetration grade, or performance grade.
- e. Number of blows of hammer per side of molded specimen.
- f. Laboratory mixing temperature.
- g. Lab compaction temperature.
- h. Temperature-viscosity relationship of the asphalt cement.

- i. Plot of the combined gradation on the 0.45 power gradation chart, stating the nominal maximum size.
- j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight versus asphalt content as shown in AI MS-2.
- k. Specific gravity and absorption of each aggregate.
- l. Percent natural sand.
- m. Percent particles with 2 or more fractured faces (in coarse aggregate).
- n. Fine aggregate angularity.
- o. Percent flat or elongated particles (in coarse aggregate).
- p. Tensile Strength Ratio(TSR).
- q. Antistrip agent (if required) and amount.
- r. List of all modifiers and amount.
- s. Percentage and properties (asphalt content, binder properties, and aggregate properties) of reclaimed asphalt pavement (RAP) in accordance with paragraph RECYCLED HOT-MIX ASPHALT, if RAP is used.

Table 3. Marshall Design Criteria

<u>Test Property</u>	<u>75 Blow Mix</u>
Stability, newtons minimum	*8000
Flow, 0.25 mm	8-16
Air voids, percent	3-5
Percent Voids in mineral aggregate (VMA), (minimum)	
Gradation 1	14.0
Gradation 2	15.0
TSR, minimum percent	75

* This is a minimum requirement. The average during construction shall be significantly higher than this number to ensure compliance with the specifications.

** Calculate VMA in accordance with AI MS-2, based on ASTM D 2726 bulk specific gravity for the aggregate.

2.3.2 Adjustments to Field JMF

The Laboratory JMF for each mixture shall be in effect until a new formula is approved in writing by the Contracting Officer. Should a change in sources of any materials be made, a new laboratory JMF design shall be performed and a new JMF approved before the new material is used. The Contractor will be allowed to adjust the Laboratory JMF within the limits specified below to optimize mix volumetric properties with the approval of the Contracting Officer. Adjustments to the Laboratory JMF shall be applied to the field (plant) established JMF and limited to those values as shown. Adjustments shall be targeted to produce or nearly produce 4 percent voids total mix (VTM).

TABLE 4.

Field (Plant) Established JMF Tolerances	
Sieves	Adjustments (plus or minus), percent
12.5 mm	3
4.75 mm	3
2.36 mm	3
0.075 mm	1
Binder Content	0.4

If adjustments are needed that exceed these limits, a new mix design shall be developed. Tolerances given above may permit the aggregate grading to be outside the limits shown in Table 2; while not desirable, this is acceptable.

2.4 RECYCLED HOT MIX ASPHALT

Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 50 mm. The recycled HMA mix shall be designed using procedures contained in AI MS-2 and AI MS-22. The job mix shall meet the requirements of paragraph MIX DESIGN. The amount of RAP shall not exceed 30 percent.

2.4.1 RAP Aggregates and Asphalt Cement

The blend of aggregates used in the recycled mix shall meet the requirements of paragraph AGGREGATES. The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure.

2.4.2 RAP Mix

The blend of new asphalt cement and the RAP asphalt binder shall meet the viscosity requirements in paragraph ASPHALT CEMENT BINDER. The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph ASPHALT CEMENT BINDER.

PART 3 EXECUTION

3.1 PREPARATION OF ASPHALT BINDER MATERIAL

The asphalt cement material shall be heated avoiding local overheating and providing a continuous supply of the asphalt material to the mixer at a uniform temperature. The temperature of unmodified asphalts shall be no more than 160 degrees C when added to the aggregates. Modified asphalts shall be no more than 174 degrees C when added to the aggregates.

3.2 PREPARATION OF MINERAL AGGREGATE

The aggregate for the mixture shall be heated and dried prior to mixing. No damage shall occur to the aggregates due to the maximum temperature and rate of heating used. The temperature of the aggregate and mineral filler shall not exceed 175 degrees C when the asphalt cement is added. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

3.3 PREPARATION OF HOT-MIX ASPHALT MIXTURE

The aggregates and the asphalt cement shall be weighed or metered and introduced into the mixer in the amount specified by the JMF. The combined materials shall be mixed until the aggregate obtains a uniform coating of asphalt binder and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but no less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to at least achieve 95 percent of coated particles. The moisture content of all hot-mix asphalt upon discharge from the plant shall not exceed 0.5 percent by total weight of mixture as measured by ASTM D 1461.

3.4 PREPARATION OF THE UNDERLYING SURFACE

Immediately before placing the hot mix asphalt, the underlying course shall be cleaned of dust and debris. A tack coat shall be applied in accordance with the contract specifications.

3.5 TEST SECTION

Prior to full production, the Contractor shall place a test section for each JMF used. The contractor shall construct a test section 75 - 150 m long and two paver passes wide placed for two lanes, with a longitudinal cold joint. The test section shall be of the same depth as the course which it represents. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment and personnel used in construction of the test section shall be the same equipment to be used on the remainder of the course represented by the test section. The test section shall be placed as part of the project pavement as approved by the Contracting Officer.

3.5.1 Sampling and Testing for Test Section

One random sample shall be taken at the plant, triplicate specimens compacted, and tested for stability, flow, and laboratory air voids. A portion of the same sample shall be tested for aggregate gradation and asphalt content. Four randomly selected cores shall be taken from the finished pavement mat, and four from the longitudinal joint, and tested for density. Random sampling shall be in accordance with procedures contained in ASTM D 3665. The test results shall be within the tolerances shown in Table 5 for work to continue. If all test results meet the specified requirements, the test section shall remain as part of the project pavement. If test results exceed the tolerances shown, the test section shall be removed and replaced at no cost to the Government and another test section shall be constructed. The test section shall be paid for with the first lot of paving

Table 5. Test Section Requirements for Material and Mixture Properties

<u>Property</u>	<u>Specification Limit</u>
Aggregate Gradation-Percent Passing (Individual Test Result)	
4.75 mm and larger	JMF plus or minus 8
2.36, 1.18, 0.60, and 0.30 mm	JMF plus or minus 6
0.15 and 0.075 mm	JMF plus or minus 2.0
Asphalt Content, Percent (Individual Test Result)	JMF plus or minus 0.5
Laboratory Air Voids, Percent (Average of 3 specimens)	JMF plus or minus 1.0
VMA, Percent (Average of 3 specimens)	14 minimum
Stability, newtons (Average of 3 specimens)	8000 minimum
Flow, 0.25 mm (Average of 3 specimens)	8 - 16
Mat Density, Percent of Marshall (Average of 4 Random Cores)	97.0 - 100.5
Joint Density, Percent of Marshall (Average of 4 Random Cores)	95.5 - 100.5

3.5.2 Additional Test Sections

If the initial test section should prove to be unacceptable, the necessary adjustments to the JMF, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Full production shall not begin until an acceptable section has been constructed and accepted.

3.6 TESTING LABORATORY

The laboratory used to develop the JMF shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements or clearly listing all deficiencies shall be submitted to the Contracting Officer prior to the start of construction. The certification shall contain as a minimum:

- a. Qualifications of personnel; laboratory manager, supervising technician, and testing technicians.
- b. A listing of equipment to be used in developing the job mix.
- c. A copy of the laboratory's quality control system.
- d. Evidence of participation in the AASHTO Materials Reference Laboratory (AMRL) program.

3.7 TRANSPORTING AND PLACING

3.7.1 Transporting

The hot-mix asphalt shall be transported from the mixing plant to the site in clean, tight vehicles. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Adequate artificial lighting shall be provided for night placements. Hauling over freshly placed material will not be permitted until the material has been compacted as specified, and allowed to cool to 60 degrees C.

3.7.2 Placing

The mix shall be placed and compacted at a temperature suitable for obtaining density, surface smoothness, and other specified requirements. Upon arrival, the mixture shall be placed to the full width by an asphalt paver; it shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the asphalt mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of 3 m. The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 300 mm; however, the joint in the surface course shall be at the centerline of the pavement. Transverse joints in one course shall be offset by at least 3 m from transverse joints in the previous course. Transverse joints in adjacent lanes shall be offset a minimum of 3 m. On isolated areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

3.8 COMPACTION OF MIXTURE

After placing, the mixture shall be thoroughly and uniformly compacted by rolling. The surface shall be compacted as soon as possible without causing displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the

discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once. Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained. To prevent adhesion of the mixture to the roller, the wheels shall be kept properly moistened but excessive water will not be permitted. In areas not accessible to the roller, the mixture shall be thoroughly compacted with hand tampers. Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or is in any way defective shall be removed full depth, replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching will not be allowed.

3.9 JOINTS

The formation of joints shall be made ensuring a continuous bond between the courses and to obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

3.9.1 Transverse Joints

The roller shall not pass over the unprotected end of the freshly laid mixture, except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing material at the joint. The cutback material shall be removed from the project. In both methods, all contact surfaces shall be given a light tack coat of asphalt material before placing any fresh mixture against the joint.

3.9.2 Longitudinal Joints

Longitudinal joints which are irregular, damaged, uncompacted, cold (less than 80 degrees C at the time of placing adjacent lanes), or otherwise defective, shall be cut back a minimum of 50 mm from the edge with a cutting wheel to expose a clean, sound vertical surface for the full depth of the course. All cutback material shall be removed from the project. All contact surfaces shall be given a light tack coat of asphalt material prior to placing any fresh mixture against the joint. The Contractor will be allowed to use an alternate method if it can be demonstrated that density, smoothness, and texture can be met.

3.10 CONTRACTOR QUALITY CONTROL

3.10.1 General Quality Control Requirements

The Contractor shall develop an approved Quality Control Plan. Hot-mix asphalt for payment shall not be produced until the quality control plan has been approved. The plan shall address all elements which affect the quality of the pavement including, but not limited to:

- a. Mix Design
- b. Aggregate Grading

- c. Quality of Materials
- d. Stockpile Management
- e. Proportioning
- f. Mixing and Transportation
- g. Mixture Volumetrics
- h. Moisture Content of Mixtures
- i. Placing and Finishing
- j. Joints
- k. Compaction
- l. Surface Smoothness

3.10.2 Testing Laboratory

The Contractor shall provide a fully equipped asphalt laboratory located at the plant or job site. The laboratory shall meet the requirements as required in ASTM D 3666. The effective working area of the laboratory shall be a minimum of 14 square meters with a ceiling height of not less than 2.3 m. Lighting shall be adequate to illuminate all working areas. It shall be equipped with heating and air conditioning units to maintain a temperature of 24 degrees C plus or minus 2.3 degrees C. Laboratory facilities shall be kept clean and all equipment shall be maintained in proper working condition. The Contracting Officer shall be permitted unrestricted access to inspect the Contractor's laboratory facility, to witness quality control activities, and to perform any check testing desired. The Contracting Officer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to adversely affect test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are corrected.

3.10.3 Quality Control Testing

The Contractor shall perform all quality control tests applicable to these specifications and as set forth in the Quality Control Program. The testing program shall include, but shall not be limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, moisture in the asphalt mixture, laboratory air voids, stability, flow, in-place density, grade and smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

3.10.3.1 Asphalt Content

A minimum of two tests to determine asphalt content will be performed per lot (a lot is defined in paragraph MATERIAL ACCEPTANCE) by one of the following methods: the extraction method in accordance with ASTM D 2172, Method A or B, the ignition method in accordance

with the AASHTO TP53 or ASTM D 6307, or the nuclear method in accordance with ASTM D 4125, provided the nuclear gauge is calibrated for the specific mix being used. For the extraction method, the weight of ash, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture.

3.10.3.2 Gradation

Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of recovered aggregate in accordance with ASTM D 5444. When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix plants. For batch plants, aggregates shall be tested in accordance with ASTM C 136 using actual batch weights to determine the combined aggregate gradation of the mixture.

3.10.3.3 Temperatures

Temperatures shall be checked at least four times per lot, at necessary locations, to determine the temperature at the dryer, the asphalt cement in the storage tank, the asphalt mixture at the plant, and the asphalt mixture at the job site.

3.10.3.4 Aggregate Moisture

The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

3.10.3.5 Moisture Content of Mixture

The moisture content of the mixture shall be determined at least once per lot in accordance with ASTM D 1461 or an approved alternate procedure.

3.10.3.6 Laboratory Air Voids, Marshall Stability and Flow

Mixture samples shall be taken at least four times per lot and compacted into specimens, using 75 blows per side with the Marshall hammer as described in ASTM D 1559. After compaction, the laboratory air voids of each specimen shall be determined, as well as the Marshall stability and flow.

3.10.3.7 In-Place Density

The Contractor shall conduct any necessary testing to ensure the specified density is achieved. A nuclear gauge may be used to monitor pavement density in accordance with ASTM D 2950.

3.10.3.8 Grade and Smoothness

The Contractor shall conduct the necessary checks to ensure the grade and smoothness requirements are met in accordance with paragraph MATERIAL ACCEPTANCE.

3.10.3.9 Additional Testing

Any additional testing, which the Contractor deems necessary to control the process, may be performed at the Contractor's option.

3.10.3.10 QC Monitoring

The Contractor shall submit all QC test results to the Contracting Officer on a daily basis as the tests are performed. The Contracting Officer reserves the right to monitor any of the Contractor's quality control testing and to perform duplicate testing as a check to the Contractor's quality control testing.

3.10.4 Sampling

When directed by the Contracting Officer, the Contractor shall sample and test any material which appears inconsistent with similar material being produced, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

3.10.5 Control Charts

For process control, the Contractor shall establish and maintain linear control charts on both individual samples and the running average of last four samples for the parameters listed in Table 6, as a minimum. These control charts shall be posted as directed by the Contracting Officer and shall be kept current at all times. The control charts shall identify the project number, the test parameter being plotted, the individual sample numbers, the Action and Suspension Limits listed in Table 6 applicable to the test parameter being plotted, and the Contractor's test results. Target values from the JMF shall also be shown on the control charts as indicators of central tendency for the cumulative percent passing, asphalt content, and laboratory air voids parameters. When the test results exceed either applicable Action Limit, the Contractor shall take immediate steps to bring the process back in control. When the test results exceed either applicable Suspension Limit, the Contractor shall halt production until the problem is solved. The Contractor shall use the control charts as part of the process control system for identifying trends so that potential problems can be corrected before they occur. Decisions concerning mix modifications shall be made based on analysis of the results provided in the control charts. The Quality Control Plan shall indicate the appropriate action which shall be taken to bring the process into control when certain parameters exceed their Action Limits.

Table 6. Action and Suspension Limits for the Parameters to be Plotted on Individual and Running Average Control Charts

Action Parameter to be Plotted	Suspension Limit	Running Average of Individual Samples		Last Four Samples	
		Action Limit	Suspension Limit	Action Limit	Suspension Limit
4.75 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	6	8	4	5	
0.6 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	4	6	3	4	
0.075 mm sieve, Cumulative % Passing, deviation from JMF target; plus or minus values	1.4	2.0	1.1	1.5	
Stability, newtons (minimum) 75 Blow JMF	8000	7560	8440	8000	
Flow, 0.25 mm 75 Blow JMF	8 min. 16 max.	7 min. 17 max.	9 min. 15 max.	8 min. 16 max.	
Asphalt content, % deviation from JMF target; plus or minus value	0.4	0.5	0.2	0.3	
Laboratory Air Voids, % deviation from JMF target value	No specific action and suspension limits set since this parameter is used to determine percent payment				
In-place Mat Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment				
In-place Joint Density, % of Marshall density	No specific action and suspension limits set since this parameter is used to determine percent payment				

3.11 MATERIAL ACCEPTANCE

Testing for acceptability of work will be performed by an independent laboratory hired by the Contractor. Test results and payment calculations shall be forwarded daily to the Contracting Officer. Acceptance of the plant produced mix and in-place requirements will be on a lot to lot basis. A standard lot for all requirements will be equal to 8 hours of production. Grade and surface smoothness determinations will be made on the lot as a whole. Exceptions or adjustments to this will be made in situations where the mix within one lot is placed as part of both the intermediate and surface courses, thus grade and smoothness measurements for the entire lot cannot be made. In order to evaluate laboratory air voids and in-place (field) density, each lot will be divided into four equal sublots.

3.11.1 Lot Acceptance

When a lot of material fails to meet the specification as outlined in the following paragraphs, that lot shall be removed and replaced, or corrected as described below, at no additional cost to the Government.

3.11.2 Sublot Sampling

One random mixture sample for determining laboratory air voids, theoretical maximum density, and for any additional testing the Contracting Officer desires, will be taken from a loaded truck delivering mixture to each subplot, or other appropriate location for each subplot. All samples will be selected randomly, using commonly recognized methods of assuring randomness conforming to ASTM D 3665 and employing tables of random numbers or computer programs. Laboratory air voids will be determined from three laboratory compacted specimens of each subplot sample in accordance with ASTM D 1559. The specimens will be compacted within 2 hours of the time the mixture was loaded into trucks at the asphalt plant. Samples will not be reheated prior to compaction and insulated containers will be used as necessary to maintain the temperature.

3.11.3 Additional Sampling and Testing

The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. The cost of any additional testing will be paid for by the Government. Testing in these areas will be in addition to the lot testing, and the requirements for these areas will be the same as those for a lot.

3.11.4 Laboratory Air Voids

Laboratory air voids will be calculated by determining the Marshall density of each lab compacted specimen using ASTM D 2726 and determining the theoretical maximum density of every other subplot sample using ASTM D 2041. Laboratory air void calculations for each subplot will use the latest theoretical maximum density values obtained, either for that subplot or the previous subplot. The mean absolute deviation of the four laboratory air void contents (one from each subplot) from the JMF air void content will be evaluated as follows, and acceptance determined per Table 7. All laboratory air void tests will be completed and reported within 24 hours after completion of construction of each lot.

3.11.5 Mean Absolute Deviation

An example of the computation of mean absolute deviation for laboratory air voids is as follows: Assume that the laboratory air voids are determined from 4 random samples of a lot (where 3 specimens were compacted from each sample). The average laboratory air voids for each subplot sample are determined to be 3.5, 3.0, 4.0, and 3.7. Assume that the target air voids from the JMF is 4.0. The mean absolute deviation is then:

$$\begin{aligned}\text{Mean Absolute Deviation} &= (|3.5 - 4.0| + |3.0 - 4.0| + |4.0 - 4.0| + |3.7 - 4.0|)/4 \\ &= (0.5 + 1.0 + 0.0 + 0.3)/4 = (1.8)/4 = 0.45\end{aligned}$$

The mean absolute deviation for laboratory air voids is determined to be 0.45. It can be seen from Table 7 that the lot is accepted based on laboratory air voids.

Table 7. Acceptance Based on Laboratory Air Voids

Mean Absolute Deviation of Lab Air Voids from JMF

0.60 or less	Accept
0.61, and above	Reject

3.11.6 In-place Density

3.11.6.1 General Density Requirements

For determining in-place density, one random core will be taken by the Contractor from the mat (interior of the lane) of each subplot, and one random core will be taken from the joint (immediately over joint) of each subplot. Each random core will be full thickness of the layer being placed. When the random core is less than 25 mm thick, it will not be included in the analysis. In this case, another random core will be taken. After air drying to a constant weight, cores obtained from the mat and from the joints will be used for in-place density determination.

3.11.6.2 Mat and Joint Densities

The average in-place mat and joint densities are expressed as a percentage of the average Marshall density for the lot. The Marshall density for each lot will be determined as the average Marshall density of the four random samples (3 specimens compacted per sample). The average in-place mat density and joint density for a lot are determined and compared with Table 8 as described below. The area associated with the joint is then determined and will be considered to be 3 m wide times the length of completed longitudinal construction joint in the lot. This area will not exceed the total lot size. The length of joint to be considered will be that length where a new lane has been placed against an adjacent lane of hot-mix asphalt pavement, either an adjacent freshly paved lane or one paved at any time previously. The area associated with the joint is expressed as a percentage of the total lot area. Acceptance for both mat density and joint density are determined from Table 8.

Table 8. In-place Density Acceptance

<u>Average Mat Density</u> <u>(4 Cores)</u>		<u>Average Joint Density</u> <u>(4 Cores)</u>
97.9 to 100	Accept	96.4 or above
97.8 and below, or 100.1 and above	Reject	96.3, and below

3.11.7 Grade

The final wearing surface of pavement shall conform to the elevations and cross sections shown and shall vary not more than 15 mm from the plan grade established and approved at site of work. Finished surfaces at juncture with other pavements shall coincide with finished surfaces of abutting pavements. Deviation from the plan elevation will not be permitted in areas of pavements where closer conformance with planned elevation is required for the

proper functioning of drainage and other appurtenant structures involved. The final wearing surface of the pavement will be tested for conformance with specified plan grade requirements. The grade will be determined by running lines of levels at intervals of 7.6 m, or less, longitudinally and transversely, to determine the elevation of the completed pavement surface. Within 5 working days, after the completion of a particular lot incorporating the final wearing surface, the Contracting Officer will inform the Contractor in writing, of the results of the grade-conformance tests. When more than 5 percent of all measurements made within a lot are outside the 15 mm tolerance, or where the grade exceeds the tolerance by more than 50 percent, the Contractor shall remove the surface lift full depth; the Contractor shall then replace the lift with hot-mix asphalt to meet specification requirements, at no additional cost to the Government. Diamond grinding may be used to remove high spots to meet grade requirements. Skin patching for correcting low areas or planing or milling for correcting high areas will not be permitted.

3.11.8 Surface Smoothness

The Contractor shall use one of the following methods to test and evaluate surface smoothness of the pavement. All testing shall be performed in the presence of the Contracting Officer. Detailed notes of the results of the testing shall be kept and a copy furnished to the Government immediately after each day's testing. The profilograph method shall be used for all longitudinal and transverse testing, except where the runs would be less than 60 m in length and the ends where the straightedge shall be used. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.), the surface shall be finished to meet the approval of the Contracting Officer.

3.11.8.1 Smoothness Requirements

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 6 mm or more, and all pavements shall be within the tolerances specified in Table 9 when checked with an approved 4 m straightedge.

<u>Table 9. Straightedge Surface Smoothness--Pavements</u>		
<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Tolerance, mm</u>
All paved areas	Longitudinal	6
	Transverse	6

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 3 mm or more, and all pavement shall have a Profile Index not greater than specified in Table 10 when tested with an approved California-type profilograph. If the extent of the pavement in either direction is less than 60 m, that direction shall be tested by the straightedge method and shall meet requirements specified above.

<u>Table 10. Profilograph Surface Smoothness--Pavements</u>		
<u>Pavement Category</u>	<u>Direction of Testing</u>	<u>Maximum Specified Profile Index (mm/km)</u>
All Paved Areas	Longitudinal	140

3.11.8.2 Testing Method

After the final rolling, but not later than 24 hours after placement, the surface of the pavement in each entire lot shall be tested by the Contractor in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. Separate testing of individual sublots is not required. If any pavement areas are ground, these areas shall be retested immediately after grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 8 m or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane for lines less than 6.1 m and at the third points for lanes 6.1 m or greater. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints.

a. Straightedge Testing. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. The amount of surface irregularity shall be determined by placing the freestanding (unleveled) straightedge on the pavement surface and allowing it to rest upon the two highest spots covered by its length, and measuring the maximum gap between the straightedge and the pavement surface in the area between these two high points.

b. Profilograph Testing. Profilograph testing shall be performed using approved equipment and procedures described in CDT Test 526. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for the pavement. The "blanking band" shall be 5 mm wide and the "bump template" shall span 25 mm with an offset of 10 mm. The profilograph shall be operated by an approved, factory-trained operator on the alignments specified above. A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

3.11.8.3 Acceptance for Smoothness

a. Straightedge Testing. Location and deviation from straightedge for all measurements shall be recorded. When over 5.0 percent of all measurements made within a lot exceed the tolerance specified in paragraph Smoothness Requirements above, after any reduction of high spots or removal and replacement, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 50 percent, shall be corrected by diamond grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

b. Profilograph Testing. Location and data from all profilograph measurements shall be recorded. When the Profile Index of a lot exceeds the tolerance specified in paragraph Smoothness Requirements above by 16 mm/km after any reduction of high spots or removal and replacement, the lot shall be removed and replaced at no additional cost to the Government. Regardless of the above, any small individual area with surface deviation which exceeds the tolerance given above by more than 79 mm/km or more, shall be corrected by grinding to meet the specification requirements above or shall be removed and replaced at no additional cost to the Government.

c. Bumps ("Must Grind" Areas). Any bumps ("must grind" areas) shown on the profilograph trace which exceed 10 mm in height shall be reduced by diamond grinding until they do not exceed 7.5 mm when retested. Such grinding shall be tapered in all directions to

provide smooth transitions to areas not requiring grinding. The following will not be permitted: (1) skin patching for correcting low areas, (2) planing or milling for correcting high areas. At the Contractor's option, pavement areas, including ground areas, may be rechecked with the profilograph in order to record a lower Profile Index.

END OF SECTION

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SECTION 02748

BITUMINOUS TACK COAT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 140	(200) Sampling Bituminous Materials
ASTM D 1250	(1980; R 1997el) Petroleum Measurement Tables
ASTM D 2397	(1998) Cationic Emulsified Asphalt
ASTM D 2995	(1999) Determining Application Rate of Bituminous Distributors

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-06 Test Reports

Sampling and Testing

Copies of all test results for bituminous materials, within 24 hours of completion of tests. Certified copies of the manufacturer's test reports indicating compliance with applicable specified requirements, not less than 30 days before the material is required in the work.

1.3 PLANT, EQUIPMENT, MACHINES AND TOOLS

1.3.1 General Requirements

Plant, equipment, machines and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times.

1.3.2 Bituminous Distributor

The distributor shall have pneumatic tires of such size and number to prevent rutting, shoving or otherwise damaging the base surface or other layers in the pavement structure. The distributor shall be designed and equipped to spray the bituminous material in a uniform

coverage at the specified temperature, at readily determined and controlled rates with an allowable variation from the specified rate of not more than plus or minus 5 percent, and at variable widths. Distributor equipment shall include a separate power unit for the bitumen pump, full-circulation spray bars, tachometer, pressure gauges, volume-measuring devices, adequate heaters for heating of materials to the proper application temperature, a thermometer for reading the temperature of tank contents, and a hand hose attachment suitable for applying bituminous material manually to areas inaccessible to the distributor. The distributor shall be equipped to circulate and agitate the bituminous material during the heating process.

1.3.3 Power Brooms and Power Blowers

Power brooms and power blowers shall be suitable for cleaning the surfaces to which the bituminous coat is to be applied.

1.4 WEATHER LIMITATIONS

Bituminous coat shall be applied only when the surface to receive the bituminous coat is dry. Bituminous coat shall be applied only when the atmospheric temperature in the shade is 10 degrees C or above and when the temperature has not been below 2 degrees C for the 12 hours prior to application.

PART 2 PRODUCTS

2.1 TACK COAT

Emulsified asphalt shall conform to ASTM D 2397, Grade CSS-1, CSS-1h, or CRS-1.

PART 3 EXECUTION

3.1 PREPARATION OF SURFACE

Immediately before applying the bituminous coat, all loose material, dirt, clay, or other objectionable material shall be removed from the surface to be treated. The surface shall be dry and clean at the time of treatment.

3.2 APPLICATION RATE

The exact quantities within the range specified, which may be varied to suit field conditions, will be determined by the Contracting Officer.

3.2.1 Tack Coat

Bituminous material for the tack coat shall be applied in quantities of not less than 0.20 liter nor more than 0.70 liter per square meter of pavement surface.

3.3 APPLICATION TEMPERATURE

3.3.1 Viscosity Relationship

Asphalt application temperature shall provide an application viscosity between 10 and 60 seconds, Saybolt Furol, or between 20 and 120 square mm/sec, kinematic. The temperature viscosity relation shall be furnished to the Contracting Officer.

3.3.2 Temperature Ranges

The viscosity requirements shall determine the application temperature to be used. The following is a normal range of application temperatures:

Emulsions

CRS-1	52-85 degrees C
CSS-1	21-60 degrees C
SS-1h	21-60 degrees C

*These temperature ranges exceed the flash point of the material and care should be taken in their heating.

3.4 APPLICATION

3.4.1 General

Following preparation and subsequent inspection of the surface, the bituminous coat shall be applied at the specified rate with uniform distribution over the surface to be treated. All areas and spots missed by the distributor shall be properly treated with the hand spray. Until the succeeding layer of pavement is placed, the surface shall be maintained by protecting the surface against damage and by repairing deficient areas at no additional cost to the Government. If required, clean dry sand shall be spread to effectively blot up any excess bituminous material. No smoking, fires, or flames other than those from the heaters that are a part of the equipment shall be permitted within 8 meters of heating, distributing, and transferring operations of bituminous material other than bituminous emulsions. All traffic, except for paving equipment used in constructing the surfacing, shall be prevented from using the underlying material, whether primed or not, until the surfacing is completed. The bituminous coat shall conform to all requirements as described herein.

3.4.2 Tack Coat

Tack coat shall be applied at the locations shown on the drawings.

3.5 CURING PERIOD

Following application of the bituminous material and prior to application of the succeeding layer of pavement, the bituminous coat shall be allowed to cure and to obtain evaporation of any volatiles or moisture.

3.6 FIELD QUALITY CONTROL

Samples of the bituminous material used shall be obtained by the Contractor as directed, under the supervision of the Contracting Officer. The sample may be retained and tested by the Government at no cost to the Contractor.

3.7 SAMPLING AND TESTING

Sampling and testing shall be performed by an approved commercial testing laboratory or by facilities furnished by the Contractor. No work requiring testing will be permitted until the facilities have been inspected and approved.

3.7.1 Sampling

The samples of bituminous material, unless otherwise specified, shall be in accordance with ASTM D 140. Sources from which bituminous materials are to be obtained shall be selected and notification furnished the Contracting Officer within 15 days after the award of the contract.

3.7.2 Calibration Test

The Contractor shall furnish all equipment, materials, and labor necessary to calibrate the bituminous distributor. Calibration shall be made with the approved job material and prior to applying the bituminous coat material to the prepared surface. Calibration of the bituminous distributor shall be in accordance with ASTM D 2995.

3.7.3 Trial Applications

Before providing the complete bituminous coat, three lengths of at least 30 meters for the full width of the distributor bar shall be applied to evaluate the amount of bituminous material that can be satisfactorily applied.

3.7.3.1 Tack Coat Trial Application Rate

Unless otherwise authorized, the trial application rate of bituminous tack coat materials shall be applied in the amount of 0.20 liters per square meter. Other trial applications shall be made using various amounts of material as may be deemed necessary.

3.7.4 Sampling and Testing During Construction

Quality control sampling and testing shall be performed as required in paragraph FIELD QUALITY CONTROL.

END OF SECTION

SECTION 02763

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS TT-B-1325	(Rev C; Notice 1; Canc. Notice 2) Beads (Glass Spheres) Retro-Reflective (Metric)
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment;

Lists of proposed equipment, including descriptive data, and notifications of proposed Contractor actions as specified in this section. List of removal equipment shall include descriptive data indicating area of coverage per pass, pressure adjustment range, tank and flow capacities, and safety precautions required for the equipment operation.

Composition Requirements;

Manufacturer's current printed product description and Material Safety Data Sheets (MSDS) for each type paint/color proposed for use.

Qualifications;

Document certifying that personnel are qualified for equipment operation and handling of chemicals.

SD-06 Test Reports

Sampling and Testing;

Certified copies of the test reports, prior to the use of the materials at the jobsite. Testing shall be performed in an approved independent laboratory.

SD-07 Certificates

Volatile Organic Compound (VOC);

Certificate stating that the proposed pavement marking paint meets the VOC regulations of the local Air Pollution Control District having jurisdiction over the geographical area in which the project is located.

1.4 DELIVERY AND STORAGE

All materials shall be delivered and stored in sealed containers that plainly show the designated name, formula or specification number, batch number, color, date of manufacture, manufacturer's name, and directions, all of which shall be plainly legible at time of use.

1.5 EQUIPMENT

All machines, tools and equipment used in the performance of the work shall be approved and maintained in satisfactory operating condition. Equipment operating on roads shall display low speed traffic markings and traffic warning lights.

1.5.1 Paint Application Equipment

The equipment to apply paint to pavements shall be a self-propelled or mobile-drawn pneumatic spraying machine with suitable arrangements of atomizing nozzles and controls to obtain the specified results. The machine shall have a speed during application not less than 8 kilometers per hour and shall be capable of applying the stripe widths indicated, at the paint coverage rate specified in paragraph APPLICATION, and of even uniform thickness with clear-cut edges. Equipment used for marking streets shall be capable of placing the prescribed number of lines at a single pass as solid lines, intermittent lines or a combination of solid and intermittent lines using a maximum of two different colors of paint as specified. The paint applicator shall have paint reservoirs or tanks of sufficient capacity and suitable gauges to apply paint in accordance with requirements specified. Tanks shall be equipped with suitable air-driven mechanical agitators. The spray mechanism shall be equipped with quick-action valves conveniently located, and shall include necessary pressure regulators and gauges in full view and reach of the operator. Paint strainers shall be installed in paint supply lines to ensure freedom from residue and foreign matter that may cause malfunction of the spray guns. The paint applicator shall be readily adaptable for attachment of an air-actuated dispenser for the reflective media approved for use. Pneumatic spray guns shall be provided for hand application of paint in areas where the mobile paint applicator cannot be used.

1.5.5 Surface Preparation Equipment

1.5.5.2 Waterblast Equipment

The water pressure shall be specified at 17.9 MPa at 60 degrees C in order to adequately clean the surfaces to be marked.

1.5.6 Marking Removal Equipment

Equipment shall be mounted on rubber tires and shall be capable of removing markings from the pavement without damaging the pavement surface or joint sealant. Waterblasting equipment shall be capable of producing an adjustable, pressurized stream of water.

1.5.7 Traffic Controls

Suitable warning signs shall be placed near the beginning of the worksite and well ahead of the worksite for alerting approaching traffic from both directions. Small markers shall be placed along newly painted lines or freshly placed raised markers to control traffic and prevent damage to newly painted surfaces or displacement of raised pavement markers. Painting equipment shall be marked with large warning signs indicating slow-moving painting equipment in operation.

1.6 HAND-OPERATED, PUSH-TYPE MACHINES

Hand-operated, push-type machines are applicable only in locations where self-propelled or mobile-drawn pneumatic spraying machine can not be used. All machines, tools, and equipment used in performance of the work shall be approved and maintained in satisfactory operating condition. Hand-operated push-type machines of a type commonly used for application of paint to pavement surfaces will be acceptable for marking small streets and parking areas. Applicator machine shall be equipped with the necessary paint tanks and spraying nozzles, and shall be capable of applying paint uniformly at coverage specified. Sandblasting equipment shall be provided as required for cleaning surfaces to be painted. Hand-operated spray guns shall be provided for use in areas where push-type machines cannot be used.

1.7 MAINTENANCE OF TRAFFIC

1.7.2 Roads, Streets, and Parking Areas

When traffic must be rerouted or controlled to accomplish the work, the necessary warning signs, flagpersons, and related equipment for the safe passage of vehicles shall be provided.

1.8 WEATHER LIMITATIONS FOR REMOVAL

Pavement surface shall be free of snow, ice, or slush. Surface temperature shall be at least 5 degrees C 40 degrees F and rising at the beginning of operations, except those involving shot or sand blasting. Operation shall cease during thunderstorms. Operation shall cease during rainfall, except for waterblasting and removal of previously applied chemicals. Waterblasting shall cease where surface water accumulation alters the effectiveness of material removal.

PART 2 PRODUCTS

2.1 PAINT

The paint shall be homogeneous, easily stirred to smooth consistency, and shall show no hard settlement or other objectionable characteristics during a storage period of 6 months. Paints for roads, and streets shall conform to FS TT-P-1952, color as indicated. Pavement marking paints shall comply with applicable state and local laws enacted to ensure

compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

2.6 SAMPLING AND TESTING

Materials proposed for use shall be stored on the project site in sealed and labeled containers, or segregated at source of supply, sufficiently in advance of needs to allow 60 days for testing. Upon notification by the Contractor that the material is at the site or source of supply, a sample shall be taken by random selection from sealed containers by the Contractor in the presence of a representative of the Contracting Officer. Samples shall be clearly identified by designated name, specification number, batch number, manufacturer's formulation number, project contract number, intended use, and quantity involved. Testing shall be performed in an approved independent laboratory. Costs associated with testing shall be at the expense of the Contractor. If materials are approved based on reports furnished by the Contractor, samples will be retained by the Government for possible future testing should the material appear defective during or after application.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces to be marked shall be thoroughly cleaned before application of the pavement marking material. Dust, dirt, and other granular surface deposits shall be removed by sweeping, blowing with compressed air, rinsing with water or a combination of these methods as required. Rubber deposits, surface laitance, existing paint markings, and other coatings adhering to the pavement shall be completely removed with scrapers, wire brushes, or mechanical abrasion as directed. Areas of old pavement affected with oil or grease shall be scrubbed with several applications of trisodium phosphate solution or other approved detergent or degreaser, and rinsed thoroughly after each application. After cleaning, oil-soaked areas shall be sealed with cut shellac to prevent bleeding through the new paint. Pavement surfaces shall be allowed to dry, when water is used for cleaning, prior to striping or marking. Surfaces shall be recleaned, when work has been stopped due to rain.

3.1.2 Cleaning Existing Pavement Markings

In general, markings shall not be placed over existing pavement marking patterns. Existing pavement markings, which are in good condition but interfere or conflict with the newly applied marking patterns, shall be removed. Deteriorated or obscured markings that are not misleading or confusing or interfere with the adhesion of the new marking material do not require removal. Whenever grinding, scraping, or other operations are performed the work must be conducted in such a manner that the finished pavement surface is not damaged or left in a pattern that is misleading or confusing. When these operations are completed the pavement surface shall be blown off with compressed air to remove residue and debris resulting from the cleaning work.

3.1.3 Cleaning Concrete Curing Compounds

On new Portland cement concrete pavements, cleaning operations shall not begin until a minimum of 30 days after the placement of concrete. All new concrete pavements shall be cleaned by either sandblasting or water blasting. When water blasting is performed, thermoplastic and preformed markings shall be applied no sooner than 24 hours after the

blasting has been completed. The extent of the blasting work shall be to clean and prepare the concrete surface as follows:

- a. There is no visible evidence of curing compound on the peaks of the textured concrete surface.
- b. There are no heavy puddled deposits of curing compound in the valleys of the textured concrete surface.
- c. All remaining curing compound is intact; all loose and flaking material is removed.
- d. The peaks of the textured pavement surface are rounded in profile and free of sharp edges and irregularities.
- e. The surface to be marked is dry.

3.2 APPLICATION

All pavement markings and patterns shall be placed as shown on the plans.

3.2.1 Paint

Paint shall be applied to clean, dry surfaces, and only when air and pavement temperatures are above 5 degrees C and less than 35 degrees C. Paint temperature shall be maintained within these same limits. New asphalt pavement surfaces and new Portland concrete cement shall be allowed to cure for a period of not less than 30 days before applications of paint. Paint shall be applied pneumatically with approved equipment at rate of coverage specified. The Contractor shall provide guide lines and templates as necessary to control paint application. Special precautions shall be taken in marking numbers, letters, and symbols. Edges of markings shall be sharply outlined.

3.2.1.1 Rate of Application

Nonreflective Markings: Paint shall be applied evenly to the pavement surface to be coated at a rate of 2.9 plus or minus 0.5 square meter per liter.

3.2.1.2 Drying

The maximum drying time requirements of the paint specifications will be strictly enforced to prevent undue softening of bitumen, and pickup, displacement, or discoloration by tires of traffic. If there is a delay in drying of the markings, painting operations shall be discontinued until cause of the slow drying is determined and corrected.

3.3 MARKING REMOVAL

Pavement marking, including plastic tape, shall be removed in the areas shown on the drawings. Removal of marking shall be as complete as possible without damage to the surface. Aggregate shall not be exposed by the removal process. After the markings are removed, the cleaned pavement surfaces shall exhibit adequate texture for remarking as specified in paragraph SURFACE PREPARATION. Contractor shall demonstrate removal of

pavement marking in an area designated by the Contracting Officer. The demonstration area will become the standard for the remainder of the work.

3.3.1 Equipment Operation

Equipment shall be controlled and operated to remove markings from the pavement surface, prevent dilution or removal of binder from underlying pavement, and prevent emission of blue smoke from asphalt or tar surfaces.

3.3.2 Cleanup and Waste Disposal

The worksite shall be kept clean of debris and waste from the removal operations. Cleanup shall immediately follow removal operations in areas subject to air traffic. Debris shall be disposed of at approved sites.

END OF SECTION

SECTION 02770

CONCRETE SIDEWALKS AND CURBS AND GUTTERS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182 (1991) Burlap Cloth Made from Jute or Kenaf

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185 (1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

ASTM A 615/A 615M (1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM A 616/A 616M (1996a) Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 617/A 617M (1996a) Axle-Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM C 31/C 31M (1996) Making and Curing Concrete Test Specimens in the Field

ASTM C 143 (1990a) Slump of Hydraulic Cement Concrete

ASTM C 171 (1997) Sheet Materials for Curing Concrete

ASTM C 172 (1997) Sampling Freshly Mixed Concrete

ASTM C 173 (1996) Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 231 (1997) Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C 309 (1997) Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C 920 (1995) Elastomeric Joint Sealants

ASTM C 936	(1996) Solid Concrete Interlocking Paving Units
ASTM C 979	(1999) Pigments for Integrally Colored Concrete
ASTM D 1751	(1983; R 1991) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 3405	(1996) Joint Sealants, Hot-Applied, for Concrete and Asphalt Pavements

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. "ED" indicates review to be performed by the designer and "RE" indicates review to be performed by the Resident Engineer. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Concrete

Copies of certified delivery tickets for all concrete used in the construction.

Concrete Pattern; G, ED.
Concrete Color; G, ED.
Concrete Texture; G, ED.

At least 30 days prior to the installation of the concrete sidewalk pattern, color, and texture, the Contractor shall submit the type of system to be utilized. Included shall be the manufacturer's recommendations and installation requirements.

SD-04 Samples

Imprinted Concrete Patterning Tool; G, RE.

Materials and/or tools to be used for the construction of the imprinted sidewalk, including manufacturer's instructions for application, shall be submitted a minimum of 15 days prior to their intended use on the project.

Concrete Paving Block; G, RE.

A sample of five paving blocks of each size prior to the start of the work.

SD-06 Test Reports

Field Quality Control

Copies of all test reports within 24 hours of completion of the test.

1.3 WEATHER LIMITATIONS

1.3.1 Placing During Cold Weather

Concrete placement shall not take place when the air temperature reaches 5 degrees C and is falling, or is already below that point. Placement may begin when the air temperature reaches 2 degrees C and is rising, or is already above 5 degrees C. Provisions shall be made to protect the concrete from freezing during the specified curing period. If necessary to place concrete when the temperature of the air, aggregates, or water is below 2 degrees C, placement and protection shall be approved in writing. Approval will be contingent upon full conformance with the following provisions. The underlying material shall be prepared and protected so that it is entirely free of frost when the concrete is deposited. Mixing water and aggregates shall be heated as necessary to result in the temperature of the in-place concrete being between 10 and 30 degrees C. Methods and equipment for heating shall be approved. The aggregates shall be free of ice, snow, and frozen lumps before entering the mixer. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period.

1.3.2 Placing During Warm Weather

The temperature of the concrete as placed shall not exceed 30 degrees C except where an approved retarder is used. The mixing water and/or aggregates shall be cooled, if necessary, to maintain a satisfactory placing temperature. The placing temperature shall not exceed 35 degrees C at any time.

1.4 PLANT, EQUIPMENT, MACHINES, AND TOOLS

1.4.1 General Requirements

Plant, equipment, machines, and tools used in the work shall be subject to approval and shall be maintained in a satisfactory working condition at all times. The equipment shall have the capability of producing the required product, meeting grade controls, thickness control and smoothness requirements as specified. Use of the equipment shall be discontinued if it produces unsatisfactory results. The Contracting Officer shall have access at all times to the plant and equipment to ensure proper operation and compliance with specifications.

1.6.2 Slip Form Equipment

Slip form paver or curb forming machine, will be approved based on trial use on the job and shall be self-propelled, automatically controlled, crawler mounted, and capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in 1 pass.

1.5 FIELD TEST PANELS

Field test panels shall be constructed prior to beginning of work using the materials and procedures proposed for use on the job, to demonstrate the results to be attained. The quality and appearance of each panel shall be subject to the approval of the Contracting Officer, and if not judged satisfactory, additional panels shall be constructed until approval is attained. Formed or finished surfaces in the completed structure shall match the quality and appearance of the approved field test panels.

1.5.1 General Requirements

An imprinted concrete sidewalk slab test panel, at least four x four sidewalk panels in size and at thickness indicated, shall be constructed to demonstrate the imprinted sidewalk slab pattern, color, and texture. Panels shall be located as directed by the Contracting Officer. Each panel shall have a full length joint line.

PART 2 PRODUCTS

2.1 CONCRETE

Concrete shall conform to the applicable requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except as otherwise specified. Concrete shall have a minimum compressive strength of 24 MPa at 28 days. Maximum size of aggregate shall be 37.5 mm.

2.1.1 Air Content

Mixtures shall have air content by volume of concrete of 5 to 7 percent, based on measurements made immediately after discharge from the mixer.

2.1.2 Slump

The concrete slump shall be 50 mm plus or minus 25 mm where determined in accordance with ASTM C 143.

2.1.3 Reinforcement Steel

Reinforcement bars shall conform to ASTM A 615/A 615M, ASTM A 616/A 616M, or ASTM A 617/A 617M. Wire mesh reinforcement shall conform to ASTM A 185.

2.2 CONCRETE CURING MATERIALS

2.2.1 Impervious Sheet Materials

Impervious sheet materials shall conform to ASTM C 171, type optional, except that polyethylene film, if used, shall be white opaque.

2.2.2 Burlap

Burlap shall conform to AASHTO M 182.

2.2.3 White Pigmented Membrane-Forming Curing Compound

White pigmented membrane-forming curing compound shall conform to ASTM C 309, Type 2.

2.3 CONCRETE PROTECTION MATERIALS

Concrete protection materials shall be a linseed oil mixture of equal parts, by volume, of linseed oil and either mineral spirits, naphtha, or turpentine. At the option of the contractor, commercially prepared linseed oil mixtures, formulated specifically for application to concrete to provide protection against the action of deicing chemicals may be used, except that emulsified mixtures are not acceptable.

2.4 JOINT FILLER STRIPS

2.4.1 Contraction Joint Filler for Curb and Gutter

Contraction joint filler for curb and gutter shall consist of hard-pressed fiberboard.

2.4.2 Expansion Joint Filler, Premolded

Expansion joint filler, premolded, shall conform to ASTM D 1751 or ASTM D 1752, 10 mm thick, unless otherwise indicated. Expansion joint filler material shall be compatible with the joint sealant selected for use by the Contractor.

2.5 JOINT SEALANTS

2.5.1 Joint Sealant, Cold-Applied

Joint sealant, cold-applied shall conform to ASTM C 920.

2.5.2 Joint Sealant, Hot-Poured

Joint sealant, hot-poured shall conform to ASTM D 3405.

2.6 FORM WORK

Form work shall be designed and constructed to ensure that the finished concrete will conform accurately to the indicated dimensions, lines, and elevations, and within the tolerances specified. Forms shall be of wood or steel, straight, of sufficient strength to resist springing during depositing and consolidating concrete. Wood forms shall be surfaced plank, 50 mm thickness, straight and free from warp, twist, loose knots, splits or other defects. Wood forms shall have a nominal length of 3 m. Radius bends may be formed with 19 mm boards, laminated to the required thickness. Steel forms shall be channel-formed sections with a flat top surface and with welded braces at each end and at not less than two intermediate points. Ends of steel forms shall be interlocking and self-aligning. Steel forms shall include flexible forms for radius forming, corner forms, form spreaders, and fillers. Steel forms shall have a nominal length of 3 m with a minimum of 3 welded stake pockets per form. Stake pins shall be solid steel rods with chamfered heads and pointed tips designed for use with steel forms.

2.6.1 Sidewalk Forms

Sidewalk forms shall be of a height equal to the full depth of the finished sidewalk.

2.6.2 Curb and Gutter Forms

Curb and gutter outside forms shall have a height equal to the full depth of the curb or gutter. The inside form of curb shall have batter as indicated and shall be securely fastened to and supported by the outside form. Rigid forms shall be provided for curb returns, except that benders or thin plank forms may be used for curb or curb returns with a radius of 3 m or more, where grade changes occur in the return, or where the central angle is such that a rigid form with a central angle of 90 degrees cannot be used. Back forms for curb returns may be made of 38 mm benders, for the full height of the curb, cleated together. In lieu of inside forms for curbs, a curb "mule" may be used for forming and finishing this surface, provided the results are approved.

2.7 CONCRETE PATTERN, COLOR, AND TEXTURE

Where indicated on the contract drawings, the concrete sidewalk shall be patterned, colored, and textured as follows:

2.7.1 Sidewalk Concrete Pattern

a. Where indicated on the drawings, the concrete sidewalk shall be an imprinted random pattern of variegated-size, slate-textured stone blocks and natural mortar joints. The pattern shall be Yorkstone by Patterned Concrete Industries, LTD., 1-800-252-4619; Formal Ashlar Stone by Stamped Concrete USA, 1-800-533-4702; Courtyard Slate by Symons Corporation, 1-847-298-3200; or approved equal.

b. Where indicated on the drawings, the concrete sidewalk shall be imprinted with a running bond brick or soldier course brick pattern as noted. The patterns shall be as available from the same manufacturers as listed above in para. a. or approved equal.

2.7.2 Sidewalk Concrete Color

Where indicated on the drawings, the concrete sidewalk shall be integrally-colored "tan" or "adobe buff" using an approved concrete dye. The pigmentation for integrally-colored concrete shall conform to ASTM C979. Color of concrete sidewalk shall match color of concrete paving blocks described in Paragraph 2.9.

2.7.3 Sidewalk Concrete Texturing

Where indicated on the drawings, the concrete sidewalk shall be textured using a slate to match pattern description in Paragraph 2.7.1.a or brick texture to match pattern description in para. 2.7.1.b.

2.8 BEDDING AND JOINTING SAND

Two separate sand gradations shall be used for the bedding layer and in the block joints. Both sand gradations shall consist of crushed sand, natural sand, or a combination of crushed and natural sand. Both sand gradations shall have a minimum L.A. Abrasion of 40

percent when tested in accordance with ASTM C 131. Both sand gradations shall be nonplastic when tested in accordance with ASTM D 4318 and shall be free of lumps, clay, vegetation, soft particles, sulfates, and other contaminants. The bedding and jointing sands shall conform to the following gradations, determined in accordance with ASTM C 136 and ASTM C 117, using ASTM E 11 sieve.

Sieve (ASTM E 11)	Percent Passing	
	Bedding Sand	Jointing Sand
9.5 mm	100	100
4.75 mm	80-100	100
2.36 mm	60-90	95-100
1.18 mm	25-70	70-100
0.600 mm	10-35	40-75
0.300 mm	5-20	10-40
0.150 mm	0-10	2-25
0.075 mm	0-5	0-10

2.9 CONCRETE PAVING BLOCK

The concrete paving block shall conform to ASTM C 936, and shall be approximately 41 mm to 51 mm thick. The concrete paving blocks shall be square, 300 mm x 300 mm or 450 mm x 450 mm as indicated on the drawings. Paving blocks shall be Terra-Paver by Wausau Tile, Hydra-Prest Paving Slabs by Weston, Hydrapressed Slabs by Abbotsford, or approved equal. Concrete paving blocks shall be colored "tan" with a shot-blasted finish as noted on the drawings and shall have a 6.3 mm chamfer on all top edges. Pigmentation shall conform to ASTM C 979. Color of concrete paving blocks and color of imprinted concrete sidewalks shall match.

2.10 ADDITIONAL CONCRETE PAVING BLOCKS

In addition to the concrete paving blocks installed in the project, the Contractor shall provide an additional 10% of each type, color, size, etc. of concrete paving block utilized. The blocks shall be delivered on pallets to the area designated by the Contracting Officer's Representative for future use and repair.

PART 3 EXECUTION

3.1 SUBGRADE PREPARATION

The subgrade shall be constructed to the specified grade and cross section prior to concrete placement. Subgrade shall be placed and compacted in conformance with Section 02300, EARTHWORK.

3.1.1 Sidewalk Subgrade

The subgrade shall be tested for grade and cross section with a template extending the full width of the sidewalk and supported between side forms.

3.1.2 Curb and Gutter Subgrade

The subgrade shall be tested for grade and cross section by means of a template extending the full width of the curb and gutter. The subgrade shall be of materials equal in bearing quality to the subgrade under the adjacent pavement.

3.1.3 Maintenance of Subgrade

The subgrade shall be maintained in a smooth, compacted condition in conformity with the required section and established grade until the concrete is placed. The subgrade shall be in a moist condition when concrete is placed. The subgrade shall be prepared and protected to produce a subgrade free from frost when the concrete is deposited.

3.2 FORM SETTING

Forms shall be set to the indicated alignment, grade and dimensions. Forms shall be held rigidly in place by a minimum of 3 stakes per form placed at intervals not to exceed 1.2 meters. Corners, deep sections, and radius bends shall have additional stakes and braces, as required. Clamps, spreaders, and braces shall be used where required to ensure rigidity in the forms. Forms shall be removed without injuring the concrete. Bars or heavy tools shall not be used against the concrete in removing the forms. Any concrete found defective after form removal shall be promptly and satisfactorily repaired. Forms shall be cleaned and coated with form oil each time before concrete is placed. Wood forms may, instead, be thoroughly wetted with water before concrete is placed, except that with probable freezing temperatures, oiling is mandatory.

3.2.1 Sidewalks

Forms for sidewalks shall be set with the upper edge true to line and grade with an allowable tolerance of 3 mm in any 3 m long section. After forms are set, grade and alignment shall be checked with a 3 m straightedge. Forms shall have a transverse slope of 20 millimeters per meter with the low side adjacent to the roadway, unless otherwise indicated. Side forms shall not be removed for 12 hours after finishing has been completed.

3.2.2 Curbs and Gutters

The forms of the front of the curb shall be removed not less than 2 hours nor more than 6 hours after the concrete has been placed. Forms back of curb shall remain in place until the face and top of the curb have been finished, as specified for concrete finishing. Gutter forms shall not be removed while the concrete is sufficiently plastic to slump in any direction.

3.3 SIDEWALK CONCRETE PLACEMENT AND FINISHING

3.3.1 Formed Sidewalks

Concrete shall be placed in the forms in one layer. When consolidated and finished, the sidewalks shall be of the thickness indicated. After concrete has been placed in the forms, a strike-off guided by side forms shall be used to bring the surface to proper section to be compacted. The concrete shall be consolidated with an approved vibrator, and the surface shall be finished to grade with a strike off.

3.3.2 Concrete Finishing

After straightedging, when most of the water sheen has disappeared, and just before the concrete hardens, the surface shall be finished with a wood float or darby to a smooth and uniformly fine granular or sandy texture free of waves, irregularities, or tool marks. A scored surface shall be produced by brooming with a fiber-bristle brush in a direction transverse to that of the traffic, followed by edging.

3.3.3 Edge and Joint Finishing

All slab edges, including those at formed joints, shall be finished with an edger having a radius of 3 mm. Transverse joint shall be edged before brooming, and the brooming shall eliminate the flat surface left by the surface face of the edger. Corners and edges which have crumbled and areas which lack sufficient mortar for proper finishing shall be cleaned and filled solidly with a properly proportioned mortar mixture and then finished.

3.3.4 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 8 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm.

3.4 CURB AND GUTTER CONCRETE PLACEMENT AND FINISHING

3.4.1 Formed Curb and Gutter

Concrete shall be placed to the section required in a single lift. Consolidation shall be achieved by using approved mechanical vibrators. Curve shaped gutters shall be finished with a standard curb "mule".

3.4.2 Curb and Gutter Finishing

Approved slipformed curb and gutter machines may be used in lieu of hand placement.

3.4.3 Concrete Finishing

Exposed surfaces shall be floated and finished with a smooth wood float until true to grade and section and uniform in texture. Floated surfaces shall then be brushed with a fine-hair brush with longitudinal strokes. The edges of the gutter and top of the curb shall be rounded with an edging tool to a radius of 13 mm. Immediately after removing the front curb form, the face of the curb shall be rubbed with a wood or concrete rubbing block and water until blemishes, form marks, and tool marks have been removed. The front curb surface, while still wet, shall be brushed in the same manner as the gutter and curb top. The top surface of gutter and entrance shall be finished to grade with a wood float.

3.4.4 Joint Finishing

Curb edges at formed joints shall be finished as indicated.

3.4.5 Surface and Thickness Tolerances

Finished surfaces shall not vary more than 6 mm from the testing edge of a 3 m straightedge. Permissible deficiency in section thickness will be up to 6 mm.

3.5 CONCRETE BLOCK PLACEMENT

3.5.1 Sand Bedding Layer

The bedding sand shall be spread evenly directly and shall be screeded to an average thickness as recommended by the manufacturer. This bedding sand shall not be used to fill low areas that exceed the specified tolerance for the base. The sand shall be lightly compacted and shall not be disturbed by any pedestrian or vehicle construction traffic. A layer of geotextile and gravel base course shall be provided under pavers, below sand bedding, in areas where no planting occurs and as detailed on the drawings.

3.5.2 Block Placement

The concrete paving blocks shall be placed by hand in the indicated pattern. Concrete paving patterns and layouts indicated on the drawings are approximate and shall be verified by the Contractor prior to installation. Placement of paving blocks shall start from a corner or straight edge and proceed forward over the undisturbed sand bedding. The joints or gaps between paving blocks shall be typically 150mm or as indicated on the drawings. Blocks shall be installed to receive river rock mulch or groundcover planting and bark mulch between concrete paving blocks as indicated on the drawings.

3.5.2.1 Unfilled Gaps

Any gaps between paving blocks and any sidewalk edge, drainage structures, or other members that cannot be filled with a whole block shall be filled with a paving block cut to fit the gap, except that slivers will not be allowed. The minimum size of triangular or odd-shaped cut block shall be 150mm on any one side. Cutting shall be done with a hydraulic splitter, a masonry saw, or other device that accurately leaves a clean, vertical face without spalling.

3.5.2.2 Seating Blocks

The concrete paving blocks shall be seated in the bedding sand by compacting them with a minimum of three passes of a vibratory plate compactor.

3.6 SIDEWALK JOINTS

Sidewalk joints shall be constructed to divide the surface into rectangular areas. Transverse contraction joints shall be spaced at a distance equal to the sidewalk width or 1.5 m on centers, whichever is less, and shall be continuous across the slab. Longitudinal contraction joints shall be constructed along the centerline of all sidewalks 3 m or more in width. Transverse expansion joints shall be installed at sidewalk returns and opposite expansion joints in adjoining curbs. Where the sidewalk is not in contact with the curb, transverse expansion joints shall be installed as indicated. Expansion joints shall be formed about structures and features which project through or into the sidewalk pavement, using joint filler of the type, thickness, and width indicated.

3.6.1 Sidewalk Contraction Joints

The contraction joints shall be formed in the fresh concrete by cutting a groove in the top portion of the slab to a depth of at least one-fourth of the sidewalk slab thickness, using a jointer to cut the groove, or by sawing a groove in the hardened concrete with a power-driven saw, unless otherwise approved. Sawed joints shall be constructed by sawing a groove in the concrete with a 3 mm blade to the depth indicated. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operations.

3.6.2 Sidewalk Expansion Joints

Expansion joints shall be formed with 10 mm joint filler strips. Joint filler shall be placed with top edge 6 mm below the surface and shall be held in place with steel pins or other devices to prevent warping of the filler during floating and finishing. Immediately after finishing operations are completed, joint edges shall be rounded with an edging tool having a radius of 3 mm, and concrete over the joint filler shall be removed. At the end of the curing period, expansion joints shall be cleaned and filled with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.6.3 Reinforcement Steel Placement

Where indicated, reinforcement steel shall be accurately and securely fastened in place with suitable supports and ties before the concrete is placed.

3.7 CURB AND GUTTER JOINTS

Curb and gutter joints shall be constructed at right angles to the line of curb and gutter.

3.7.1 Contraction Joints

Contraction joints shall be constructed directly opposite contraction joints in abutting portland cement concrete pavements and spaced so that monolithic sections between curb returns will not be less than 1.5 m nor greater than 4.5 m in length. Contraction joints shall be constructed by means of 3 mm thick separators and of a section conforming to the cross section of the curb and gutter. Separators shall be removed as soon as practicable after concrete has set sufficiently to preserve the width and shape of the joint and prior to finishing.

3.7.2 Expansion Joints

Expansion joints shall be formed by means of preformed expansion joint filler material cut and shaped to the cross section of curb and gutter. Expansion joints shall be provided in curb and gutter directly opposite expansion joints of abutting portland cement concrete pavement, and shall be of the same type and thickness as joints in the pavement. Where curb and gutter do not abut portland cement concrete pavement, expansion joints at least 10 mm in width shall

be provided at intervals not less than 10 meters nor greater than 35 meters. Expansion joints shall be provided in nonreinforced concrete gutter at locations indicated. Expansion joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Expansion joints and the top 25 mm depth of curb and gutter contraction-joints shall be sealed with joint sealant. The joint opening shall be thoroughly cleaned before the sealing material is placed. Sealing material shall not be spilled on exposed surfaces of the concrete. Concrete at the joint shall be surface dry and atmospheric and concrete temperatures shall be above 10 degrees C at the time of application of joint sealing material. Excess material on exposed surfaces of the concrete shall be removed immediately and concrete surfaces cleaned.

3.8 CURING AND PROTECTION

3.8.1 General Requirements

Concrete shall be protected against loss of moisture and rapid temperature changes for at least 7 days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. Protection shall be provided as necessary to prevent cracking of the pavement due to temperature changes during the curing period.

3.8.1.1 Mat Method

The entire exposed surface shall be covered with 2 or more layers of burlap. Mats shall overlap each other at least 150 mm. The mat shall be thoroughly wetted with water prior to placing on concrete surface and shall be kept continuously in a saturated condition and in intimate contact with concrete for not less than 7 days.

3.8.1.2 Impervious Sheeting Method

The entire exposed surface shall be wetted with a fine spray of water and then covered with impervious sheeting material. Sheets shall be laid directly on the concrete surface with the light-colored side up and overlapped 300 mm when a continuous sheet is not used. The curing medium shall not be less than 450 mm wider than the concrete surface to be cured, and shall be securely weighted down by heavy wood planks, or a bank of moist earth placed along edges and laps in the sheets. Sheets shall be satisfactorily repaired or replaced if torn or otherwise damaged during curing. The curing medium shall remain on the concrete surface to be cured for not less than 7 days.

3.8.1.3 Membrane Curing Method

A uniform coating of white-pigmented membrane-curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as the free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than 1 hour after the removal of forms. Concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water and the curing compound applied as soon as the free water disappears. Curing compound shall be applied in two coats by hand-operated pressure sprayers at a coverage of approximately 5 square meters per liter (200 square feet per gallon) for the total of both coats. The second

coat shall be applied in a direction approximately at right angles to the direction of application of the first coat. The compound shall form a uniform, continuous, coherent film that will not check, crack, or peel and shall be free from pinholes or other imperfections. If pinholes, abrasion, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed. Necessary precautions shall be taken to insure that the concrete is properly cured at sawed joints, and that no curing compound enters the joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed before the concrete in the region of the joint is resprayed with curing compound. The method used for sealing the joint groove shall prevent loss of moisture from the joint during the entire specified curing period. Approved standby facilities for curing concrete pavement shall be provided at a location accessible to the jobsite for use in the event of mechanical failure of the spraying equipment or other conditions that might prevent correct application of the membrane-curing compound at the proper time. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

3.8.2 Backfilling

After curing, debris shall be removed and the area adjoining the concrete shall be backfilled, graded, and compacted to conform to the surrounding area in accordance with lines and grades indicated.

3.8.3 Protection

Completed concrete shall be protected from damage until accepted. The Contractor shall repair damaged concrete and clean concrete discolored during construction. Concrete that is damaged shall be removed and reconstructed for the entire length between regularly scheduled joints. Refinishing the damaged portion will not be acceptable. Removed damaged portions shall be disposed of as directed.

3.9 FIELD QUALITY CONTROL

3.9.1 General Requirements

The Contractor shall perform the inspection and tests described and meet the specified requirements for inspection details and frequency of testing. Based upon the results of these inspections and tests, the Contractor shall take the action and submit reports as required below, and any additional tests to insure that the requirements of these specifications are met.

3.9.2 Concrete Testing

3.9.2.1 Strength Testing

The Contractor shall provide molded concrete specimens for strength tests. Samples of concrete placed each day shall be taken not less than once a day nor less than once for every 190 cubic meters of concrete. The samples for strength tests shall be taken in accordance with ASTM C 172. Cylinders for acceptance shall be molded in conformance with ASTM C 31/C 31M by an approved testing laboratory. Each strength test result shall be the average of 2 test cylinders from the same concrete sample tested at 28 days, unless otherwise specified or approved. Concrete specified on the basis of compressive strength will be considered satisfactory if the averages of all sets of three consecutive strength test results equal or exceed the specified strength, and no individual strength test result falls below the specified strength by more than 4 MPa.

3.9.2.2 Air Content

Air content shall be determined in accordance with ASTM C 173 or ASTM C 231. ASTM C 231 shall be used with concretes and mortars made with relatively dense natural aggregates. Two tests for air content shall be made on randomly selected batches of each class of concrete placed during each shift. Additional tests shall be made when excessive variation in concrete workability is reported by the placing foreman or the Government inspector. If results are out of tolerance, the placing foreman shall be notified and he shall take appropriate action to have the air content corrected at the plant. Additional tests for air content will be performed on each truckload of material until such time as the air content is within the tolerance specified.

3.9.2.3 Slump Test

Two slump tests shall be made on randomly selected batches of each class of concrete for every 190 cubic meters, or fraction thereof, of concrete placed during each shift. Additional tests shall be performed when excessive variation in the workability of the concrete is noted or when excessive crumbling or slumping is noted along the edges of slip-formed concrete.

3.9.3 Thickness Evaluation

The anticipated thickness of the concrete shall be determined prior to placement by passing a template through the formed section or by measuring the depth of opening of the extrusion template of the curb forming machine. If a slip form paver is used for sidewalk placement, the subgrade shall be true to grade prior to concrete placement and the thickness will be determined by measuring each edge of the completed slab.

3.9.4 Surface Evaluation

The finished surface of each category of the completed work shall be uniform in color and free of blemishes and form or tool marks.

3.10 SURFACE DEFICIENCIES AND CORRECTIONS

3.10.1 Thickness Deficiency

When measurements indicate that the completed concrete section is deficient in thickness by more than 6 mm the deficient section will be removed, between regularly scheduled joints, and replaced.

3.10.2 High Areas

In areas not meeting surface smoothness and plan grade requirements, high areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine after the concrete is 36 hours old or more. The area corrected by grinding the surface of the hardened concrete shall not exceed 5 percent of the area of any integral slab, and the depth of grinding shall not exceed 6 mm. Pavement areas requiring grade or surface smoothness corrections in excess of the limits specified above shall be removed and replaced.

3.10.3 Appearance

Exposed surfaces of the finished work will be inspected by the Government and any deficiencies in appearance will be identified. Areas which exhibit excessive cracking, discoloration, form marks, or tool marks or which are otherwise inconsistent with the overall appearances of the work shall be removed and replaced.

END OF SECTION

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SECTION 02811

UNDERGROUND SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996b) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2287	(1996a) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2774	(1994) Underground Installation of Thermoplastic Pressure Piping
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

ASME INTERNATIONAL (ASME)

ASME B1.2	(1983; R 1991; Errata May 1992) Gages and Gaging for Unified Inch Screw Threads
ASME B16.3	(1992) Malleable Iron Threaded Fittings
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND
SANITARY RESEARCH (ASSE)

- | | |
|-----------|---|
| ASSE 1012 | (1995) Backflow Preventers with Intermediate Atmospheric Vent |
| ASSE 1013 | (1993) Reduced Pressure Principle Backflow Preventers |

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- | | |
|-----------|---|
| AWWA C509 | (1994; Addendum 1995) Resilient-Seated Gate Valves for Water Supply Service |
| AWWA C901 | (1996) Polyethylene (PE) Pressure Pipe and Tubing, 1/2 In. Through 3 In., for Water Service |

COMMERCIAL ITEM DESCRIPTIONS (CID)

- | | |
|---------------|---|
| CID A-A-51145 | (Rev C) Flux, Soldering, Non-Electronic, Paste & Liquid |
|---------------|---|

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC
RESEARCH (FCCCHR)

- | | |
|-----------|---|
| FCCCHR-01 | (1993) Manual of Cross-Connection Control |
|-----------|---|

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
FITTINGS INDUSTRY (MSS)

- | | |
|-----------|---|
| MSS SP-80 | (1997) Bronze Gate, Globe, Angle and Check Valves |
|-----------|---|

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

- | | |
|------------|--|
| NEMA ICS 2 | (1993) Industrial Control and Systems, Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC |
| NEMA ICS 6 | (1993) Industrial Control and Systems, Enclosures |

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- | | |
|---------|---------------------------------|
| NFPA 70 | (1999) National Electrical Code |
|---------|---------------------------------|

1.2 DESIGNER AND INSTALLER QUALIFICATIONS

Engage a firm or firms specializing in irrigation installation. The field foreman shall have a minimum of 5 years experience with the installing firm and successfully completed at least three projects similar in material and scope to the work indicated for this project. The firm responsible for the installation shall have successfully completed at least three past projects similar in

material and scope to this project including names and telephone numbers of owners/operators and date of project installation within the last two years.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. "ED" indicates review of submittal to be performed by the designer. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

Sprinkler System As-Builts; G

As-built Drawings which provide current factual information showing final locations of mains, heads, valves, and controllers including deviations from and amendments to the drawings and changes in the work during installation shall be provided. At least two coordinates shall be provided on the drawings for each control valve box and gate valve box location. As-builts shall also include system and supply pressures, weekly precipitation requirements of the area, requirements for irrigating the area in hours/minutes per day per cycle, and schedule and timing of control valves.

SD-03 Product Data

Framed Instructions; G

Labels, signs, and templates of operating instructions that are required to be mounted or installed on or near the product for normal, safe operation.

Field Training; G

Information describing training to be provided, training aids to be used, samples of training materials to be provided, and schedules and notification of training.

Sprinkler System; G

Detailed procedures defining the Contractor's provisions for accident prevention, health protection, and other safety precautions for the work to be done.

Spare Parts; G

Spare parts data for each different item of material and equipment specified, after approval of the related submittals and not later than the start of the field tests. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

SD-06 Test Reports

Field Tests; G

Performance test reports, in booklet form, showing all field tests performed to adjust each component; and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of control valves. Field tests shall include a pressure test and operation test for each zone.

SD-07 Certificates

Installer Qualifications; G

Written documentation certifying that the installer complies with paragraph, Installer Qualifications.

Sprinkler System; G

The material supplier's or equipment manufacturer's statement that the supplied material or equipment meets specified requirements. Each certificate shall be signed by an official authorized to certify in behalf of material supplier or product manufacturer and shall identify quantity and date or dates of shipment or delivery to which the certificates apply.

SD-10 Operation and Maintenance Data

Sprinkler System; G

Six copies of operation and six copies of maintenance manuals for the equipment furnished. One complete set prior to field testing and the remainder upon acceptance. Manuals shall be approved prior to the field training course.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be protected from the weather; excessive humidity, temperature variation; direct sunlight (in the case of plastic or rubber materials); dirt, dust and other contaminants.

1.5 FIELD MEASUREMENTS

The Contractor shall verify all dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 TEST WATER CONDITIONS

The Contractor shall check the pressure at the irrigation meter, or source connection, and confirm minimum operating pressure and flows provided. In the event the water pressure does not meet the minimum operating pressure at the meter (550kPA), notify Contracting Officer, state conditions, and submit a proposal for installing a booster system capable of increasing the pressure to the minimum. In the event the water pressure significantly

exceeds the operating pressure noted in this specification, provide a proposal for a pressure regulator downstream of the backflow preventer.

1.7 WARRANTY

1.7.1 Warranty all work for a period of one year, starting on the date of final acceptance of the system(s), against defects in materials, equipment, workmanship, and any repairs required resulting from leaks or other defects of workmanship, material, or equipment. During the warranty period, Contractor shall check, clean, and adjust sprinkler heads and other irrigation components as necessary to ensure adequate operation of the system.

1.7.2 Emergency repairs may be by the owner without relieving the Irrigation Contractor of his warranty obligations.

1.7.3 Repair settling of backfilled trenches occurring during the warranty period, including restoration of damaged plantings, paving, and improvements resulting from settling of trenches or repair operations.

1.7.4 Respond to owner's request for repair work within 10 days. If not, Contracting Officer will proceed with such necessary repairs at the Contractor's expense.

1.8 OPERATION AND MAINTENANCE PERIOD

The Contractor shall be responsible for the operation and maintenance of the entire irrigation system(s) installed under this contract for a period of one year starting on the date of final acceptance of the system(s). The one year operation and maintenance period for the irrigation system(s) shall coincide and be fully coordinated with the one year landscape maintenance period, see also Section 02935 Exterior Plant Material Maintenance.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer who has produced similar systems which have performed well for a minimum period of 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

2.1.2 Nameplates

Each item of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the item of equipment.

2.1.3 Extra Stock

The following extra stock shall be provided: Five sprinkler heads of each size and type, two valve keys for operating manual valves, two wrenches for removing and installing each type of head, two quick coupler keys and hose swivels, and four irrigation controller housing keys.

2.2 PIPING MATERIALS

2.2.1 Copper Tubing and Associated Fittings

Tubing shall conform to requirements of ASTM B 88M ASTM B 88, Type K. Fittings shall conform to ASME B16.22 and ASME B16.18, solder joint. Solder shall conform to ASTM B 32 95-5 tin-antimony. Flux shall conform to CID A-A-51145, Type I.

2.2.2 Red Brass Pipe and Associated Fittings

Pipe shall conform to requirements of ASTM B 43, regular. Fittings shall be Class 250, cast bronze threaded conforming to the requirements of ASME B16.15.

2.2.3 Galvanized Steel Pipe and Associated Fittings

Pipe shall conform to requirements of ASTM A 53, Schedule 40. Fittings shall be Class 150 conforming to requirements of ASME B16.3.

2.2.4 Polyvinyl Chloride (PVC) Pipe, Fittings and Solvent Cement

2.2.4.1 PVC Pipe

Pipe shall conform to the requirements of ASTM D 1785, PVC 1120 Schedule 40.

2.2.4.2 PVC Fittings

Solvent welded socket type fittings shall conform to requirements of ASTM D 2466, Schedule 40 and Schedule 80 as indicated. Threaded type fittings shall conform to requirements of ASTM D 2464, Schedule 80.

2.2.4.3 Solvent Cement and Primer

Solvent cement shall conform to the requirements of ASTM D 2564 Thread sealant and pipe joint compound shall be a non-hardening, soft setting grit-free, paste, heavy-duty gray color, that remains crushable to -45.5 degrees C. Sealant shall be safe, nontoxic, and safe for use with potable water. Primer shall be purple color as approved by the pipe manufacturer.

2.2.5 Dielectric Fittings

Dielectric fittings shall conform to ASTM F 441/F 441M, Schedule 80, CPVC threaded pipe nipples, 100 mm minimum length.

2.3 SPRINKLER AND EMITTER HEADS

2.3.1 Pop-Up Spray Heads

2.3.1.1 General Requirements

Pop-up spray heads lay flush with housing, then pop up when water pressure 138 kPa is activated in system. The rising member supporting the nozzle shall be identical on full, half, third or quarter pattern sprinklers so that nozzles will be interchangeable. The sprinkler head

shall be designed to be adjustable for coverage and flow. The nozzle shall be removable so head does not have to be removed for flushing or cleaning. Nozzle rises a minimum of 100 mm above the body for turf areas and 150mm for shrub/groundcover areas. The body shall be constructed with a 13 mm female thread for installation in a fixed underground pipe system. Sprinkler heads shall be Rainbird, Toro, Weathermatic, or Hunter.

2.3.1.2 Shrubbery Sprinkler Heads

Sprinkler heads shall be conical spray with adjustable coverage and designed for permanent in-ground mounting on pop-ups at a height compatible with ground covers. Provide plastic nozzles.

2.3.2 Rotary Pop-Up Sprinklers

Sprinklers shall be capable of covering turf or bed areas with head to head spacing where indicated on the drawings. Sprinkler diameter, distribution rate, trajectory, and maximum height of spray shall be modified by the Contractor based on the appropriate coverage for turf or bed areas. Pop-up height shall be 100mm. Construction shall be high impact molded plastic with filter screen, reducible watering radius, and choice of nozzles and have adjustable radius capabilities.

2.3.3 Bubbler Sprinkler Heads

Bubblers shall be designed for permanent in-ground mounting on risers. See details.

2.4 VALVES

2.4.1 Gate Valves, Less than 80 mm

Gate valves shall conform to the requirements of MSS SP-80, Type 1, Class 150, threaded ends.

2.4.2 Gate Valves, 80 mm and Larger

Gate valves shall conform to the requirements of AWWA C509 and have encapsulated resilient wedge, parallel seats, non-rising stems, and open by counterclockwise turning. End connections shall be flanged. Interior construction of valves shall be bronze including stem containing a maximum 2 percent aluminum and maximum 16 percent zinc.

2.4.3 Angle Valves, Less Than 65 mm

Angle valves shall conform to the requirements of MSS SP-80, Type 3, Class 150 threaded ends.

2.4.4 Angle Valves, 65 mm and Larger

Angle valves shall conform to the requirements of MSS SP-85, Type II, Class 250 threaded ends.

2.4.5 Quick Coupling Valves

Quick coupling valves shall have brass parts and shall be two-piece unit consisting of a coupler water seal valve assembly and a removable upper body to allow spring and key track to be serviced without shutdown of main. Lids shall be lockable vinyl with spring for positive closure on key removal. Non potable.

2.4.6 Remote Control Valves, Electrical

Remote control valves shall be solenoid actuated globe valves of 38 to 50mm size, suitable for 24volts, 60 cycle, and designed to provide for shut-off in event of power failure. Valve shall be cast bronze or brass or plastic housing suitable for service at 1034 kPa operating pressure with external flow control adjustment for shut-off capability, capability for manual activation, filter in control chamber to prevent valve body clogging with debris, durable diaphragm, and accessibility to internal parts without removing valve from system. Non-potable.

2.4.7 Pressure Regulating Master Valve

Pressure regulating master valve shall be automatic mechanical self-cleaning, self-purging control system having an adjustable pressure setting operated by a solenoid on alternating current with 0.70amperes at 18volts. Valve shall close slowly and be free of chatter in each diaphragm position, have manual flow stem to adjust closing speed and internal flushing, and one-inlet tappings capable of being installed as a straight pattern valve. Body shall be cast bronze or brass with removable brass seat serviceable from top without removing valve body from system. Valve shall operate at 1034 kPa working pressure and pilot range from 70 to 875 kPa. Non potable.

2.4.8.2 Double Check Type Backflow Preventers

Backflow preventers shall be Class 150 flanged bronze mounted gate valve and strainer, 304stainless steel or bronze, internal parts. Total pressure drop through complete assembly shall be a maximum of 70 kPa at rated flow. Piping shall be brass pipe and fittings. Strainers shall be bronze or brass construction with gasket caps. Units shall have 200-mesh stainless steel screen elements.

2.4.9 Automatic Filter Kit.

Filter shall be 50 mm model , capable of flows between 1,14 – 26,11 cm/hr, operating between 172 –1034 kPa. Length 300mm, Width 140mm, Height, 300mm. Filter shall have a 25mm automatic control valve (dirty water capable) for automatic flushing. Rainbird or equal.

2.5 ACCESSORIES AND APPURTENANCES

2.5.1 Valve Keys for Manually Operated Valves

Valve keys shall be 15 mm diameter by 1000 mm , tee handles and keyed to fit valves.

2.5.2 Valve Boxes and Concrete Pads

2.5.2.1 Valve Boxes

Valve boxes shall be plastic lockable for each gate valve, manual control valve and remote control valve. Remote control valve boxes shall be 300mm by 450mm standard valve box. Isolation valves, gate valves, wire splices, and quick coupling valves shall be in a 225mm round valve box with cover. All plastic valve boxes to be green in color with green colored covers. Acceptable manufacturers are Ametek, Carson, and Brooks.

2.5.3 Pressure Gauges

Pressure gauges shall conform to requirements of ASME B40.1, single style pressure gauge for water with 115 mm brass or aluminum case, bronze tube, gauge cock, pressure snubber, and siphon. Scale range shall be suitable for irrigation sprinkler systems.

2.6 AUTOMATIC CONTROLLERS, ELECTRICAL

Controllers shall conform to the requirements of NEMA ICS 2 with 120volt single phase service, operating with indicated stations, and grounded chassis. Enclosure shall conform to NEMA ICS 6 Type 3R, with locking hinged cover, wall-mounted as indicated on the drawings. Controller shall be programmed for various schedules by setting switches and dials equipped with the following features: A switch for each day of week for two schedules, allowing each station to be scheduled individually as to days of watering; a minute switch for each station with a positive increment range of 0 to 3 hours, set time within one percent; a switch allowing selected schedules to be repeated after each completion of initial watering schedule and allowing each operation to be scheduled throughout a 24-hour day; a circuit breaker for surge protection; and circuit for a 9-volt rechargeable NiCad battery. Acceptable manufacturers are Weathermatic; Toro; Rainbird; or Rainmaster.

2.6.1 Remote Control

Each irrigation controller shall have a remote control pigtail or receiver card affixed to the controller in a permanent manner. This shall be sized appropriately to operate the entire system. The irrigation contractor shall also deliver to the owner at final completion, a complete remote control unit capable of operating each individual system.

2.7 ELECTRICAL WORK

Wiring and rigid conduit for electrical power shall be in accordance with NFPA 70, and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

2.8 CONCRETE MATERIALS

Concrete shall have a compressive strength of 17MPa at 28 days as specified in Section 03300, CAST-IN-PLACE STRUCTURAL CONCRETE.

2.9 INSULATING JOINTS

Insulating joints and dielectric fittings shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

2.10 BEDDING FOR PIPE

Bedding for use in pipe and sprinkler head installation shall be clean imported sand conforming to the following:

Sand: 90-100 percent passing a 12.5mm sieve; 65-100 percent passing a 6.3mm sieve; 40-100 percent passing a 10-mesh sieve; 3-30 percent passing a 50-mesh sieve; 0-4 percent passing a 100-mesh sieve; and 0-3 percent passing a 200-mesh sieve.

All percentages are by weight.

2.12 RAIN SENSOR

Provide rain sensor with adjustable shut-off point from 3.12mm to 25mm of accumulated rainfall. Switch will interrupt common wire. Unit shall be UL approved. Acceptable manufacturers shall be Rainbird, Toro, Glen Hilton or Weathermatic.

2.11 DETECTABLE TAPE

Detectable tape shall be blue color coded detectable marking tape.

PART 3 EXECUTION

3.1 INSTALLATION

Sprinkler system shall be installed after site grading has been completed. Excavation, trenching, and backfilling for sprinkler system shall be in accordance with the applicable provisions of Section 02316, EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS, except as modified herein.

3.1.1 Trenching

Trench around roots shall be hand excavated to pipe grade when roots of 50 mm diameter or greater are encountered. Maximum trench width at tree root locations is 100mm. General trench width shall be 300 mm minimum. Trenches shall be over excavated 100 mm deeper and backfilled with bedding sand as specified in 2.11 above. Trenches shall be kept free of obstructions and debris that would damage pipe. Backfilling shall be accomplished in 150mm lifts, with the first being placed by hand to exclude all debris over 25mm and sharp edged rocks of any dimension. Mechanical tamping shall be done after each lift to eliminate trench settling. Subsoil shall not be mixed with topsoil. Existing concrete walks, drives and other obstacles shall be bored at a depth conforming to bottom of adjacent trenches. Pipe sleeves for bored pipe shall be two pipe diameters larger than sprinkler pipe.

3.1.2 Piping System

3.1.2.1 Cover

Underground piping shall be installed to meet the minimum depth of backfill cover specified.

3.1.2.2 Clearances

Minimum horizontal clearances between lines shall be 100 mm for pipe 50 mm and less; 300 mm for 65 mm and larger. Minimum vertical clearances between lines shall be 50 mm..

3.1.2.3 Minimum Slope

Minimum slope shall be 50 mm per 10 M in direction of drain valves.

3.1.2.4 Bedding and Cover

Bedding material (sand) shall be placed in the bottom of all pipe trenches prior to piping installation. Sand bedding shall be a minimum of 100mm depth. All rocks shall be removed from within 100mm of any irrigation piping. Following pipe installation, an additional 100mm sand shall be placed over the pipe providing even coverage within the trench.

3.1.3 Piping Installation

3.1.3.1 Polyvinyl Chloride (PVC) Pipe

- a. Solvent-cemented joints shall conform to the requirements of ASTM D 2855.
- b. Threaded joints shall be full cut with a maximum of three threads remaining exposed on pipe and nipples. Threaded joints shall be made tight without recourse to wicks or fillers, other than polytetrafluoroethylene thread tape.
- c. Piping shall be joined to conform with requirements of ASTM D 2774 or ASTM D 2855, and pipe manufacturer's instructions. Pipe shall be installed in a serpentine (snaked) manner to allow for expansion and contraction in trench before backfilling. Pipes shall be installed at temperatures over 5 degrees C..

3.1.3.2 Soldered Copper Tubing

Pipe shall be reamed and burrs removed. Contact surfaces of joint shall be cleaned and polished. Flux shall be applied to male and female ends. End of tube shall be inserted into fittings full depth of socket. After soldering, a solder bead shall show continuously around entire joint circumference. Excess acid flux shall be removed from tubings and fittings.

3.1.3.3 Threaded Brass or Galvanized Steel Pipe

Prior to installation, pipe shall be reamed. Threads shall be cut in conformance with ASME B1.2. Pipe joint compound shall be applied to male end only.

3.1.3.4 Insulating Joints

Insulating and dielectric fittings shall be provided where pipes of dissimilar metal are joined and at connections to water supply mains as shown. Installation shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

3.1.3.5 Detectable Tape

Detectable tape shall be provided directly above all main line piping. Tape shall be installed 300 mm above the main line and continuously be imprinted with "Caution Water Line Buried Below" using permanent black ink. See also paragraph 3.1.10.1

3.1.4 Installation of Valves

3.1.4.1 Manual Valves

Valves shall be installed in a valve box extending from grade to below valve body, with a minimum of 100 mm cover measured from finish grade to top of valve stem.

3.1.4.2 Automatic Valves

Valve shall be set plumb in a valve box extending from grade to below valve body, with minimum of 100 mm cover measured from finish grade to top of valve.

3.1.4.3 Automatic Filter Kit

Each system which will be using reclaimed storm water shall be equipped with a system which automatically flushes and cleans the filter. The filter flushing shall be synchronized with the operation of the irrigation system.

3.1.5 Sprinklers and Quick Coupling Valves

Sprinklers and valves shall be installed plumb and level with terrain. All Sprinkler heads shall be surrounded with sand bedding, 100 mm in all directions, to prevent breakage. Spray head shall be installed 150 mm away from adjacent hardscape and gear rotors shall be installed 300 mm away.

3.1.6 Backflow Preventers

Backflow preventer shall be installed in new connection to water distribution system, between connection and control valves. Backflow preventer shall be installed where indicated in a concrete utility box with proper drainage and at proper depth as detailed on the drawings.

3.1.6.2 Double Check Backflow Preventer

Double check backflow preventers shall be installed per detail provided and where indicated on the final drawings.

3.1.7 Control Wire and Conduit

3.1.7.1 Wires

Low voltage wires shall be buried beside pipe in same trench. Rigid conduit shall be provided where wires run under paving or in areas not containing irrigation piping. Wires shall be number tagged at key locations along main to facilitate service. One control circuit shall be provided for each zone and a circuit to control sprinkler system. See plan notes for spare wire locations and general wire routing.

3.1.7.2 Loops

A 600 mm loop of wire shall be provided at each valve where controls are connected.

3.1.7.3 Expansion and Contraction

Multiple wires shall be bundled and taped together at 6 M intervals and at change of direction with 300 mm loop for expansion and contraction.

3.1.7.4 Splices

Electrical splices shall be waterproof.

3.1.8 Automatic Controller

Exact field location of controllers shall be determined before installation. Approximate locations of controllers are indicated on the drawings. Coordinate the electrical service to these locations. Install in accordance with manufacturer's recommendations and NFPA 70.

3.1.9 Thrust Blocks

Concrete shall be placed so that sides subject to thrust or load are against undisturbed earth, and valves and fittings are serviceable after concrete has set. Thrust blocks are required on all mainline piping and shall be as specified in Section 02510 WATER DISTRIBUTION SYSTEM.

3.1.10 Backfill

3.1.10.1 Minimum Cover

Depth of cover shall be 300 mm for 50 mm pipe and smaller (laterals); 450 mm for 65 mm pipe and larger (mainline); 600mm for pipes under traffic loads and hardscape (sleeving); and 450mm for low-voltage wires. Remainder of trench (after bedding) shall be filled to subgrade with excavated soil. Compact soil with plate hand-held compactors to same density as undisturbed adjacent soil. Detectable tape shall be provided above all mainline and lateral line piping. Detectable tape shall be provided between the top of pipe and finish grade, at least 150mm above the pipe and no less than 150mm below finish grade.

3.1.10.2 Restoration

Top 80 mm shall be filled with topsoil and compacted with same density as surrounding soil. Lawns and plants shall be restored in accordance with Sections 02921 SEEDING, 02922 SODDING, and Section 02930 EXTERIOR PLANTING. Pavements shall be restored in accordance with Section 02551 BITUMINOUS PAVING FOR ROADS, STREETS, AND OPEN STORAGE AREAS; AND Section 02770 CONCRETE SIDEWALKS AND CURBS AND GUTTERS.

3.1.11 Adjustment

After grading and rolling of planted areas, prior to seeding, sprinkler heads shall be adjusted flush to finished grade. Adjustments shall be made by adjusting the approved swing joint, which will permit adjustment in height of head without changing piping.

3.1.12 Disinfection

Sprinkler system fed from a potable water system shall be disinfected upstream of backflow preventer in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

3.1.13 Cleaning of Piping

Prior to the hydrostatic and operation tests, the interior of the pipe shall be flushed with clean water until pipe is free of all foreign materials. Flushing and cleaning out of system pipe, valves, and components shall not be considered completed until witnessed and accepted by Contracting Officer.

3.1.14 Winterizing the System

The irrigation system shall be winterized the first winter season (on or about November 1) following substantial completion of the project in total. The irrigation piping shall be winterized by first blowing the system clear of water using compressed air (550kPa, maximum) admitted into the piping at a quick coupling valve or hose bib located at a higher elevation on the system piping. Activate individual zones, higher zones first, then proceed successively through the system towards lower elevations. Proceed through all zones twice. The air compressor used to winterize the system must have an engine separate from the compressor tanks to prevent high temperature from being injected directly into the PVC piping. One start up and one winterization is required for each independent system after final completion. Spring start-up should occur on or about March 1. Schedule and coordinate spring start-up with Fort Lewis Public Works maintenance personnel (contact available from the Contracting Officer). Provide a minimum of 4 hours on-site training to Fort Lewis Public Works maintenance personnel in the proper techniques and requirements of winterization and spring start-up of the irrigation system at all points of connection as described above.

3.2 FIELD TESTS AND FINAL INSPECTION

All instruments, equipment, facilities, and labor required to conduct the tests shall be provided by Contractor. Contractor shall not cover any work before it has been inspected, tested, and approved by the Contracting Officer. Should any of the work be covered before it has been approved, the Contractor shall, at his expense, uncover the work.

3.2.1 Hydrostatic Pressure Test

Piping shall be tested hydrostatically before backfilling and proved tight at a hydrostatic pressure of 1034 kPa without pumping for a period of one hour with an allowable pressure drop of 35 kPa. If hydrostatic pressure cannot be held for a minimum of 4 hours, Contractor shall make adjustments or replacements and the tests repeated until satisfactory results are achieved and accepted by the Contracting Officer.

3.2.2 Leakage Tests

Leakage tests for service main shall be in accordance with Section 02510 WATER DISTRIBUTION SYSTEM.

3.2.3 Operation Test

At conclusion of pressure test, sprinkler heads rotors, bubblers, quick coupling assemblies, and remote control valves shall be tested for operation under normal operating pressure. Thoroughly clean, adjust, and balance systems. Operation test consists of the system operating through at least one complete programmed cycle for all areas to be irrigated demonstrating that all heads are properly adjusted for radius and arc of coverage, that all remote control valves are properly balanced, and that the installed system is workable, clean and efficient.

3.3 INSTRUCTIONS

Instructions containing wiring and control diagrams in laminated plastic shall be posted where directed, preferably near the automatic controller. Condensed operating instructions, prepared in typed form, shall be laminated as specified above and posted beside the diagrams. The instructions shall be posted before acceptance testing of the system. After as-built drawings are approved by Contracting Officer, controller charts and programming schedule shall be prepared. One chart for each controller shall be supplied. Chart shall be a reduced drawing of actual as-built system that will fit the maximum dimensions inside controller housing. Black line print for chart and a different pastel or transparent color shall indicate each station area of coverage. After chart is completed and approved for final acceptance, chart shall be sealed between two 0.505 mm pieces of clear plastic.

3.4 FIELD TRAINING

A field training course shall be provided for designated operating and maintenance staff members. Training shall be provided for a total period of 4 hours of normal working time and shall start after the system is functionally complete but prior to final acceptance tests. Field training shall cover all of the items contained in the operating and maintenance manuals.

3.5 CLEANUP

Upon completion of installation of system, all debris and surplus materials resulting from the work shall be removed from site.

3.6 AS-BUILT DRAWINGS

The Contractor is responsible for documenting changes to the design which occur during construction. Any changes in the layout and/or arrangements of the proposed irrigation system, or any other differences between the proposed system and actual installed conditions are to be recorded by the Irrigation Contractor in the form of an "As-Built" drawing. One copy of the final design submittal drawings provided by the Contractor are to be used as the base for recording as-built information. As-Built drawings are to be clearly and neatly drawn and shall be submitted in accordance with the fronts portion of this project specification. All automatic and manual valves, hose bibs or quick couplers, and wire splice locations shall be shown with actual dimensions to reference points so they may be easily located in the field.

All locations of sprinkler heads, backflow preventers, and controllers shall be approximate. These documents must be available for inspection by the Contracting Officer throughout the construction period. The routing of buried or concealed piping must be given particular attention. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each sleeve and conduit end, pipe or wire stub-out, and other irrigation components enclosed within a valve box. Record these dimensions on the drawings provided for as-built purposes. Clarify or change the documents in accordance with the Contracting Officer's instructions at no additional cost to the Government.

3.7 OPERATION AND MAINTENANCE PERIOD

Contractor shall be responsible for maintenance and operation of the newly installed irrigation system(s) for a period of one year from final acceptance of the installed system. At the discretion of the Contracting Officer, final acceptance may be divided into areas based on points of connection to the water source for each irrigation system. Irrigation maintenance and operation shall be well-coordinated with maintenance of all turf and planting areas. See also Specification Section 02935 Exterior Plant Material Maintenance for detailed maintenance requirements.

3.8 OPERATION AND MAINTENANCE MANUALS

Complete operation and maintenance manuals shall be provided by the Contractor. Manuals shall provide step-by-step procedures required for system start-up, operation and shut-down. The manuals shall include the manufacturer's name, model number, parts list, and brief description of all equipment and their basic operating features. Manuals shall list routine maintenance procedures and trouble shooting guides. Manuals shall include one scaled copy of as-built drawings of the systems installed for easy reference and a recommended programming schedule for each automatic controller.

END OF SECTION

SECTION 02821

FENCING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 116	(1995) Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric
ASTM A 121	(1999) Zinc-Coated (Galvanized) Steel Barbed Wire
ASTM A 153/A 153M	(1998) Zinc-Coated (Hot Dip) on Iron and Steel Hardware
ASTM A 176	(1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 392	(1996) Zinc-Coated Steel Chain-Link Fence Fabric
ASTM A 478	(1997) Chromium-Nickel Stainless Steel Weaving and Knitting Wire
ASTM A 491	(1996) Aluminum-Coated Steel Chain-Link Fence Fabric
ASTM A 585	(1997) Aluminum-Coated Steel Barbed Wire
ASTM A 666	(1999) Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A 702	(1989; R 1994e1) Steel Fence Posts and Assemblies, Hot Wrought
ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
ASTM A 824	(1995) Metallic-Coated Steel Marcellled Tension Wire for Use With Chain Link Fence
ASTM C 94/C 94M	(2000) Ready-Mixed Concrete
ASTM D 4541	(1995e1) Pull-Off Strength of Coatings Using Portable Adhesion Testers

ASTM F 626	(1996a) Fence Fittings
ASTM F 668	(1999a) Poly(Vinyl Chloride) (PVC)-Coated Steel Chain-Link Fence Fabric
ASTM F 883	(1997) Padlocks
ASTM F 900	(1994) Industrial and Commercial Swing Gates
ASTM F 1043	(1999) Strength and Protective Coatings on Metal Industrial Chain-Link Fence Framework
ASTM F 1083	(1997) Specification for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures
ASTM F 1184	(1994) Industrial and Commercial Horizontal Slide Gates
ASTM G 23	(1996) Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 26	(1996) Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials
ASTM G 53	(1996) Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Chain Link Fence

Statement, signed by an official authorized to certify on behalf of the manufacturer, attesting that the chain link fence and component materials meet the specified requirements.

1.3 APPROVAL OF POLYVINYL CHLORIDE-COATED FENCE MATERIALS

Polyvinyl chloride-coated fence materials shall be thoroughly inspected for cracking, peeling, and conformance with the specifications by the Contracting Officer's Representative prior to

installation. Any fence materials rejected by the Contracting Officer's Representative shall be replaced by the contractor with approved materials at no additional cost to the Government

PART 2 PRODUCTS

2.1 FENCE FABRIC

Fence fabric shall conform to the following:

2.1.1 Chain Link Fence Fabric

ASTM A 392, Class 1, zinc-coated steel wire with minimum coating weight of 370 grams of zinc per square meter of coated surface, or ASTM A 491, Type I, aluminum-coated steel wire. Class 2b polyvinyl chloride-coated steel fabric with 92 grams of zinc coating per square meter in accordance with ASTM F 668. Fabric shall be fabricated of 9 gauge wire woven in 50 mm mesh. Polyvinyl chloride coating for fabric and all other fence components shall be manufacturer's standard black in color. Fabric height shall be as shown. Fabric shall be twisted and barbed on the top selvage and knuckled on the bottom selvage.

2.2 GATES

ASTM F 900 and/or ASTM F 1184. Gate shall be the type and swing shown. Gate frames shall conform to strength and coating requirements of ASTM F 1083 for Group IA, steel pipe, with external coating Type A, nominal pipe size (NPS) 1-1/2. Gate frames shall conform to strength and coating requirements of ASTM F 1043, for Group IC, steel pipe with external coating Type A or Type B, nominal pipe size (NPS) 1-1/2. Gate fabric shall be as specified for chain link fabric. Gate leaves more than 2.44 m wide shall have either intermediate members and diagonal truss rods or shall have tubular members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 2.44 m wide shall have truss rods or intermediate braces. Gate fabric shall be attached to the gate frame by method standard with the manufacturer except that welding will not be permitted. Latches, hinges, stops, keepers, rollers, and other hardware items shall be furnished as required for the operation of the gate. Latches shall be arranged for padlocking so that the padlock will be accessible from both sides of the gate. Stops shall be provided for holding the gates in the open position. Each end member of gate frames shall be extended sufficiently above the top member to carry three strands of barbed wire in horizontal alignment with barbed wire strands on the fence.

2.3 POSTS

2.3.1 Metal Posts for Chain Link Fence

ASTM F 1083, zinc-coated. Group IA, with external coating Type A steel pipe. Group IC steel pipe, zinc-coated with external coating Type A or Type B and Group II, formed steel sections, shall meet the strength and coating requirements of ASTM F 1043. Group III, ASTM F 1043 steel H-section may be used for line posts in lieu of line post shapes specified for the other classes. Post shall be either Group IA steel pipe, Group IC, Group II, formed steel sections, or Group III steel H-sections and shall be zinc coated (Type A) and polyvinyl chloride coating conforming to the requirements of ASTM F 1043. Sizes shall be as shown on the drawings. Line posts and terminal (corner, gate, and pull) posts selected shall be of

the same designation throughout the fence. Gate post shall be for the gate type specified subject to the limitation specified in ASTM F 900 and/or ASTM F 1184.

2.4 BRACES AND RAILS

ASTM F 1083, zinc-coated, Group IA, steel pipe, size NPS 1-1/4. Group IC steel pipe, zinc-coated, shall meet the strength and coating requirements of ASTM F 1043. Braces and rails shall be [Group IA] [Group IC], steel pipe, size NPS 1-1/4 or Group II, formed steel sections, size 42 mm and shall be zinc coated (Type A) and polyvinyl chloride-coated conforming to the requirements of ASTM F 1043. Group II, formed steel sections, size 42 mm, conforming to ASTM F 1043, may be used as braces and rails if Group II line posts are furnished.

2.5 WIRE

Tension wire shall be Type I or Type II, Class 2 coating, in accordance with ASTM A 824.

2.6 ACCESSORIES

ASTM F 626. Ferrous accessories shall be coated to match the fence fabric. Ferrous accessories shall be zinc or aluminum coated or shall also be polyvinyl chloride-coated, minimum thickness of 0.152 mm 0.006 inch, maximum thickness of 0.381 mm 0.015 inch. Color coating of fittings shall match the color coating of the fabric. Truss rods shall be furnished for each terminal post. Truss rods shall be provided with turnbuckles or other equivalent provisions for adjustment. Barbed wire shall be 2 strand, 12-1/2 gauge wire, zinc-coated, Class 3 in accordance with ASTM A 121 or aluminum coated Type I in accordance with ASTM A 585. Barbed wire shall be four-point barbed type steel wire. Barbed wire support arms shall be the single arm type and of the design required for the post furnished. Tie wire for attaching fabric to rails, braces, and posts shall be 9 gauge steel wire and match the coating of the fence fabric. Tie wires for attaching fabric to tension wire on shall be 1.6 mm stainless steel. The tie wires shall be a double loop and 165 mm in length. Miscellaneous hardware coatings shall conform to ASTM A 153/A 153M unless modified. Threaded hardware shall be painted to match polyvinyl chloride coatings.

2.7 BARBED TAPE

Reinforced barbed tape, single coil, for fence toppings shall be fabricated from 430 series stainless steel with a hardness range of Rockwell (30N) 37-45 conforming to the requirements of ASTM A 176. The stainless steel strip shall be 0.6 mm thick by 25 mm wide before fabrication. Each barb shall be a minimum of 30.5 in length, in groups of 4, spaced on 102 mm (centers. The stainless steel core wire shall have a 2.5 mm diameter with a minimum tensile strength of 9.68 MPa and shall be in accordance with ASTM A 478. [Reinforced barbed tape, single coil, for ground application shall meet the above requirements.] Sixteen gauge stainless steel twistable wire ties shall be used for attaching the barbed tape to the barbed wire and to the fence for ground application.

2.8 CONCRETE

ASTM C 94/C 94M, using 19 mm maximum size aggregate, and having minimum compressive strength of 21 MPa at 28 days. Grout shall consist of one part portland cement to three parts clean, well-graded sand and the minimum amount of water to produce a workable mix.

2.9 PADLOCKS

Padlocks shall conform to ASTM F 883, Type PO1, Options A, B, and G, Grade 6. All padlocks shall be keyed alike.

PART 3 EXECUTION

3.1 INSTALLATION

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Fence shall be installed to the lines and grades indicated. The area on either side of the fence line shall be cleared to the extent indicated. Line posts shall be spaced equidistant at intervals not exceeding 3 m . Terminal (corner, gate, and pull) posts shall be set at abrupt changes in vertical and horizontal alignment. Fabric shall be continuous between terminal posts; however, runs between terminal posts shall not exceed 152.4 m . Any damage to galvanized surfaces, including welding, shall be repaired with paint containing zinc dust in accordance with ASTM A 780.

3.2 EXCAVATION

Post holes shall be cleared of loose material. Waste material shall be spread where directed. The ground surface irregularities along the fence line shall be eliminated to the extent necessary to maintain a 50 mm clearance between the bottom of the fabric and finish grade.

3.3 POST INSTALLATION

3.3.1 Posts for Chain Link Fence

Posts shall be set plumb and in alignment. Posts shall be set in concrete to the depth indicated on the drawings. Posts set in concrete shall be set in holes not less than the diameter shown on the drawings. Concrete and grout shall be thoroughly consolidated around each post, shall be free of voids and finished to form a dome. Concrete and grout shall be allowed to cure for 72 hours prior to attachment of any item to the posts. Group II line posts may be mechanically driven, for temporary fence construction only, if rock is not encountered. Driven posts shall be set to a minimum depth of 914 mm and shall be protected with drive caps when being set. For fences, fence post rigidity shall be tested by applying a 222.4 newtons force on the post, perpendicular to the fabric, at 1.52 m above ground; post movement measured at the point where the force is applied shall be less than or equal to 19 mm from the relaxed position; every tenth post shall be tested for rigidity; when a post fails this test, further tests on the next four posts on either side of the failed post shall be made; all failed posts shall be removed, replaced, and retested at the Contractor's expense.

3.4.1 Top Rail

Top rail shall be supported at each post to form a continuous brace between terminal posts. Where required, sections of top rail shall be joined using sleeves or couplings that will allow expansion or contraction of the rail.

3.4.2 Bottom Rail

The bottom rail shall be bolted to double rail ends and double rail ends shall be securely fastened to the posts. Bolts shall be peened to prevent easy removal. Bottom rail shall be installed before chain link fabric.

3.5 BRACES AND TRUSS RODS

Braces and truss rods shall be installed as indicated and in conformance with the standard practice for the fence furnished. Horizontal (compression) braces and diagonal truss (tension) rods shall be installed on fences over 1.83 m in height. A center brace or 2 diagonal truss rods shall be installed on 3.66 m fences. Braces and truss rods shall extend from terminal posts to line posts. Diagonal braces shall form an angle of approximately 40 to 50 degrees with the horizontal. No bracing is required on fences 1.83 m high or less if a top rail is installed.

3.6 TENSION WIRES

Tension wires shall be installed along the top and bottom of the fence line and attached to the terminal posts of each stretch of the fence. Top tension wires shall be installed within the top 102 mm of the installed fabric. Bottom tension wire shall be installed within the bottom 152 mm of the installed fabric. Tension wire shall be pulled taut and shall be free of sag.

3.7 CHAIN LINK FABRIC

Chain link fabric shall be installed on the side of the post indicated. Fabric shall be attached to terminal posts with stretcher bars and tension bands. Bands shall be spaced at approximately 381 mm intervals. The fabric shall be installed and pulled taut to provide a smooth and uniform appearance free from sag, without permanently distorting the fabric diamond or reducing the fabric height. Fabric shall be fastened to line posts at approximately 381 mm intervals and fastened to all rails and tension wires at approximately 305 mm intervals. Fabric shall be cut by untwisting and removing pickets. Splicing shall be accomplished by weaving a single picket into the ends of the rolls to be joined. The bottom of the installed fabric shall be 50 mm plus or minus 13 mm above the ground. After the fabric installation is complete, the fabric shall be exercised by applying a 222 newtons push-pull force at the center of the fabric between posts; the use of a 133 newtons pull at the center of the panel shall cause fabric deflection of not more than 63.5 mm when pulling fabric from the post side of the fence; every second fence panel shall meet this requirement; all failed panels shall be resecured and retested at the Contractor's expense.

3.8 BARBED WIRE SUPPORTING ARMS AND BARBED WIRE

3.8.1 General Requirements

Barbed wire supporting arms and barbed wire shall be installed as indicated and as recommended by the manufacturer. Supporting arms shall be anchored with 9.5 mm diameter plain pin rivets or, at the Contractor's option, with studs driven by low-velocity explosive-actuated tools for steel, wrought iron, ductile iron, or malleable iron. Studs driven by an explosive-actuated tool shall not be used with gray iron or other material that can be fractured. A minimum of two studs per support arm shall be used. Barbed wire shall be pulled taut and attached to the arms with clips or other means that will prevent easy removal.

3.9 GATE INSTALLATION

Gates shall be installed at the locations shown. Hinged gates shall be mounted to swing as indicated. Latches, stops, and keepers shall be installed as required. Padlocks shall be attached to gates or gate posts with chains. Hinge pins, and hardware shall be welded or otherwise secured to prevent removal.

3.11 GROUNDING

Fences shall be grounded on each side of all gates, at each corner, at the closest approach to each building located within 15 m of the fence, and where the fence alignment changes more than 15 degrees. Grounding locations shall not exceed 198 m . Each gate panel shall be bonded with a flexible bond strap to its gate post. Fences crossed by powerlines of 600 volts or more shall be grounded at or near the point of crossing and at distances not exceeding 45 m on each side of crossing. Ground conductor shall consist of No. 8 AWG solid copper wire. Grounding electrodes shall be 19 mm by 3.05 m long copper-clad steel rod. Electrodes shall be driven into the earth so that the top of the electrode is at least 152 mm below the grade. Where driving is impracticable, electrodes shall be buried a minimum of 305 mm deep and radially from the fence. The top of the electrode shall be not less than 610 mm or more than 2.4 m from the fence. Ground conductor shall be clamped to the fence and electrodes with bronze grounding clamps to create electrical continuity between fence posts, fence fabric, and ground rods. After installation the total resistance of fence to ground shall not be greater than 25 ohms.

END OF SECTION

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SECTION 02870

SITE FURNISHINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications shall be referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997ael) Carbon Structural Steel
ASTM A 48	(1994ael) Gray Iron Castings
ASTM A 48M	(1994el) Gray Iron Castings (Metric)
ASTM A 123/A 123M	(1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 615/A 615M	(1996ael) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM B 26/B 26M	(1999) Aluminum-Alloy Sand Castings
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 108	(1999) Aluminum-Alloy Permanent Mold Castings
ASTM C 150	(1999a) Portland Cement
ASTM D 648	(1998c) Deflection Temperature of Plastics Under Flexural Load
ASTM D 2990	(1995) Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics
ASTM F 1487	(1998) Standard Consumer Safety Performance Specification for Playground Equipment for Public Use

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings, G

Site Furnishing Standards;

Drawings showing scaled details of proposed site furnishings, elevations for each type of site furnishing; dimensions, details, hardware, and methods of mounting or anchoring; shape and thickness of materials; and details of construction for the following:

- Guidon Pedestal
- Company and Battalion Signs
- Trash Receptacle
- Bench (a , c, and d)
- Picnic Table
- Barbecue Grill
- Bike Rack
- Picnic Shelter/Bike Rack Cover

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered, handled, and stored in accordance with the manufacturer's recommendations. The storage area shall be as designated. The materials shall be stored in a dry, covered area until installed.

1.4 INSPECTION

Site furnishings shall be inspected upon arrival at the job site for conformity to specifications and quality in accordance with paragraph MATERIALS. Unacceptable items shall be removed from the job site.

PART 2 PRODUCTS

2.1 GUIDON PEDESTAL

Cast in place concrete pedestal as shown on detail drawings. Concrete pad shall be formed and placed with reinforcement prepared for guidon as shown on detail drawings. Finish of pedestal shall be smooth, light sandblast.

2.2 BATTALION SIGN

Battalion sign shall be 1.5M high x 1.85M long constructed of a concrete and brick base, mortared brick posts and tube steel mounting frame. Brick color shall match brick used for

Battalion building. Frame color shall be semi-gloss black. Construction and assembly shall be as shown on detail drawings.

2.3 COMPANY SIGN

Individual Company sign structure shall be 1.06M high x 1.6M long consisting of two 200mm round reinforced concrete posts, and two horizontal 38mm x 75mm x 11 Ga. Tube steel mounting frame. Frame color shall be semi-gloss black. Construction and assembly shall be as shown on the detail drawings. Concrete finish shall be smooth, light sandblast. Sign mounts shall be 300mm x 1.1M x 3.1mm steel plate. Reinforcement shall be 4 – 10M (#3) rebar wound with Ga. 45M (#13) spiral steel wire.

2.4 TRASH RECEPTACLE

Trash receptacle shall be a 121 L-size, approx. 675mm diameter and 750mm high. Receptacle shall be constructed of 10 gauge steel frame, Plastisol coated, with a dome top lid for all-weather protection. All other steel framework shall be coated with a baked on polyester dry powder. All hardware shall be stainless steel. The receptacle exterior shall be a rib pattern or design. The insert receptacle shall come standard with a liner and adjustable glides. The receptacle shall include a surface mount post package for permanent installation. The receptacle, frame, and dome lid shall be provided in the color black. Receptacle shall be Model LRR32 by Wabash Valley Manufacturing, Inc., 1-800-253-8619 or approved equal.

2.5 BENCH

Bench types shall be provided as noted on the drawings.

- a. Type A - Model CD432 by Cambridge Design, Inc., or approved equal for bench with back. Bench shall be 1.8M long with back on black powder-coated steel frame. Bench slats shall be 75mm x 100mm constructed of recycled plastic, cedar brown color.
- b. Type C - Model CYR4185 by Wabash Valley Manufacturing, Inc., or approved equal for bench with back. Bench shall be 1.8M long. Bench shall be constructed of 10 gauge sheet steel and coated with 6.3mm of Plastisol. Bench legs shall be made from cast aluminum with surface mount for permanent installation. Plastisol and frame color shall be black.
- c. Type D - Model CYR4187 by Wabash Valley Manufacturing, Inc., or approved equal for bench without back. Bench shall be 1.8M long. Bench shall be constructed of 10 gauge sheet steel and coated with 6.3mm of Plastisol. Bench legs shall be made from cast aluminum with surface mount for permanent installation. Plastisol and frame color shall be black.

2.6 PICNIC TABLE (SEE ALSO PARA. 2.9)

Picnic tables not associated with a shelter shall be Model CD386 by Cambridge Design, Inc., or approved equal. 1M square table on center square tubular steel post (black powder-coated) with four backless benches cantilevered from center support. Table and benches constructed of 75mm x 100mm slats of recycled plastic, cedar brown color. For picnic tables associated with shelters see Paragraph 2.9.

2.7 BARBECUE GRILL

Model SB16 Grill by Kay Park-Recreation; Model FC-1193-HC by Belson Outdoors or approved equal. Grill shall have 193,500 square millimeters grill area and be a heavy-duty rotating grill, sides and back of 10 gauge galvanized steel, bottom of 7 gauge steel with ash lip. Adjustable grill to three to four cooking heights. Grill package shall include a 10 gauge hot-rolled steel hot plate, 150mm x 350mm which attaches to standard grate and utility shelf. Finish shall be non-toxic, rust-resistant, baked-on, black dry powder. Support post shall be galvanized or baked-on, black dry powder-coated. At least one grill at each barracks complex shall be universally accessible.

2.8 BIKE RACK (SEE ALSO PARA. 2.9)

Model Expo 7510 by Cora Bike Rack, Inc. or approved equal. Bike rack shall be constructed of heavy-duty quality steels. Mainframe shall be 59.5mm OD and hangers shall be 19mm minimum diameter round bars. Bike rack shall include all flanges and hardware for surface mounting and permanent installation. Mainframe and hanger finish shall be black powder coated or black plastic color coated carbon steel. Bike sizes shall be provided as noted on the drawings. Bike rack cover shall be provided separately as specified in Paragraph. 2.9 herein where noted on drawings.

2.9 PICNIC SHELTER/BIKE RACK COVER

Shelter shall be Model No. 8407 (Basic) 3M x 3M Pittsburgh Mini Shelter by Litchfield Industries, Inc. or approved equal with Survivor Series handicap accessible 2.4 M table, or approved equal. Shelter picnic tables shall be expanded steel welded to a hot rolled steel border coated with Plastisol or similar heat-fused vinyl plastic with UV stabilizer. Plastisol and frame color shall be black. For Bike Rack Cover, provide Model No. 8405 (Basic) by Litchfield Industries, Inc. or approved equal. Shelter and Bike Rack Cover shall have 26-gauge Litchtop Multi-Rib Roofing and 125mm tubular steel supports. Frame finish shall be black polyester dry powder coating. Roof color shall match metal roof color of barracks building. Bike racks shall be provided separately (see para. 2.8). Picnic shelters/bike rack covers shall be surface mounted and permanently installed in accordance with manufacturer's recommendations.

2.10 WIRE SCREEN COLUMN TRELLIS

Wire screen column trellis shall be modular panels constructed of 1.9mm galvanized steel wire welded to form a 50mm by 50mm square grid, front and back, separated by bent wire trussed either 50mm or 75mm in depth. Wire screen shall form a column trellis, 380mm diameter, 3.0 M tall, with three stakes for mounting around new concrete columns as indicated on the drawings. Secure top and bottom of wire screen trellis to concrete column per manufacturer's recommendations. All panels, trim, and miscellaneous mounting clips shall be coated with thermally-set powder paint in black finish color. Wire column trellis shall be "Greenscreen" or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall verify that finished grades and other operations affecting mounting surfaces have been completed prior to the installation of site furnishings. Site furnishings shall be installed plumb and true in accordance with the approved manufacturer's instructions. Install all site furnishings per detail drawings and per manufacturer's instructions. Install site furnishings where indicated on the drawings.

3.1.3 Application of Field Finishes

Field painting shall not be allowed.

3.1.4 Parts

New parts shall be acquired from the manufacturer. Substitute parts will not be accepted unless approved by the manufacturer.

3.1.5 Assembly

When the inspection of parts has been completed, the site furnishings shall be assembled and anchored according to manufacturer's instructions or as indicated. When site furnishings are assembled at the site, assembly shall not interfere with other operations or pedestrian and vehicular circulation.

3.1.6 Testing

Each site furnishing shall be tested to determine a secure and correct installation. A correct installation shall be according to the manufacturer's recommendations and by the following procedure: The Contractor shall measure the physical dimensions and clearance of each installed site furnishing for compliance with manufacturer's recommendations and as indicated. Site furnishings which do not comply shall be reinstalled. Fasteners and anchors determined to be non-compliant shall be replaced. A written report describing the results of the testing shall be provided.

3.1.7 Steel Frame

Tube steel used for sign mounting frame and fabrication shall conform to AISC requirements. All welded connections shall be performed in accordance with AWS D1.1 Structural Welding Code. Also see Section 05120 Structural Steel and Section 05500 Miscellaneous Metal. All screws, bolts, and anchors shall be hot-dip galvanized in accordance with ASTM A 123. All steel frames for signs shall be painted with an alkyd chrome oxide metal primer and finished with semigloss alkyd enamel paint. Color-black.

3.2 RESTORATION AND CLEAN UP

When the installation has been completed, the Contractor shall clean up and protect the site. Existing areas that have been damaged from the installation operation shall be restored to original condition at Contractor's expense.

3.2.1 Clean Up

The site shall be cleaned of all materials associated with the installation. Site furnishing surfaces shall be cleaned of dirt, stains, filings, and other blemishes occurring from shipment and installation. Cleaning methods and agents shall be according to manufacturer's instructions or as indicated. Cleaning methods and products shall not harm adjacent plant material. Damaged plant material shall be replaced by the Contractor.

3.2.2 Protection

The area shall be protected as required or directed by providing barricades and signage. Signage shall be in accordance with Section 10430 EXTERIOR SIGNAGE.

3.2.3 Disposal of Materials

Excess and waste material shall be removed and disposed off Government property.

3.3 RE-INSTALLATION

Where re-installation is required, the following shall be accomplished:

- a. Re-install the product as specified. Material acquisition of replacement parts is the responsibility of the Contractor. Provide replacement materials that are new and supplied by the original manufacturer to match.
- b. Damage caused by the failed installation shall be repaired.

END OF SECTION

SECTION 02921

SEEDING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AGRICULTURAL MARKETING SERVICE (AMS)

AMS Seed Act (1995) Federal Seed Act Regulations Part 201

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment;
Surface Erosion Control Material;
Chemical Treatment Material; G
Grass Pavement System;

Manufacturer's literature including physical characteristics, application and installation instructions for equipment, surface erosion control material and chemical treatment material.

A listing of equipment to be used for the seeding operation.

Delivery;

Delivery schedule.

Finished Grade and Topsoil; G

Finished grade status.

Quantity Check; G

Bag count or bulk weight measurements of material used compared with area covered to determine the application rate and quantity installed.

Seed Establishment Period; G

Calendar time period for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described.

Maintenance Record; G

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants. See also Specification 02935 Exterior Plant Material Maintenance.

Application of Pesticide; G

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; G

Samples taken from several locations at the source.

Soil Amendments; G

A 4.5 kg sample.

Mulch; G

A 4.5 kg sample.

SD-06 Test Reports

Equipment Calibration;

Certification of calibration tests conducted on the equipment used in the seeding operation.

Soil Test; G

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed; G
Topsoil; G
pH Adjuster;
Fertilizer;
Organic Material;
Soil Conditioner;
Mulch; G
Pesticide; G

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.
- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.
- h. Asphalt Adhesive: Composition.
- i. Pesticide. EPA registration number and registered uses.

1.3 SOURCE INSPECTION

The source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Delivered Topsoil

Prior to the delivery of any topsoil, its availability shall be verified in paragraph TOPSOIL. A soil test shall be provided for topsoil delivered to the site.

1.4.1.2 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.3 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Seed shall be inspected upon arrival at the job site for conformity to species and quality. Seed that is wet, moldy, or bears a test date five months or older, shall be rejected. Other materials shall be inspected for compliance with specified requirements. The following shall be rejected: open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 13 mm diameter; and topsoil that contains viable plants and plant parts. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

Materials shall be stored in designated areas. Seed, lime, and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.4.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Hydroseeding time limitation for holding seed in the slurry shall be a maximum 24 hours.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Seed Classification

State-certified seed of the latest season's crop shall be provided in original sealed packages bearing the producer's guaranteed analysis for percentages of mixture, purity, germination, hard seed, weed seed content, and inert material. Labels shall be in conformance with AMS Seed Act and applicable state seed laws.

2.1.2 Permanent Seed Species and Mixtures

Permanent seed species and mixtures shall be proportioned by weight as follows (see drawings for locations of each seed mix):

Botanical Name	Common Name	Mixture Percent by Weight	Percent Pure Live Seed
SEED MIX 'A'			
Lolium perenne	Turf-type Perennial Ryegrass	50%	90%
Festuca rubra Var. rubra or Var. commutata	Creeping red or chewings Fescue	50%	90%
SEED MIX 'C'			
Festuca trachy- phylla	Hard Fescue	33.33%	85%
Festuca ovina L.	Sheep Fescue	33.33%	81%
Festuca rubra L.	Red Fescue	33.33%	90%

2.1.3 Quality

Weed seed shall be a maximum 1 percent by weight of the total mixture and shall be free of restricted and prohibited noxious weed seed. The seed shall also be free of crop seed, and inert matter shall not exceed 3% by weight of the total mixture.

2.1.4 Seed Mixing

The mixing of seed may be done by the seed supplier prior to delivery, or on site as directed.

2.1.5 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 13 mm diameter. Topsoil shall be free from viable plants and plant parts.

Topsoil shall be a sandy loam and shall have a maximum particle size of 13mm with a maximum of 3 percent retained on a 6.3mm screen and a minimum of 5 percent passing through a 1.25mm screen. Topsoil shall contain 5-20 percent by volume (or 4%-7% by weight) of mixed, composted, fine-particle organic matter. The source of organic matter shall have a carbon-nitrogen ratio of 25 to 1. Topsoil shall be obtained from well-drained areas and shall not contain more than 5 percent water by volume. The topsoil shall be free from debris, noxious weeds, rhizomes, roots, toxic substances, or any other material that may be harmful to plant growth. . The pH shall be between 5.5 and 7.5. Soluble salts shall not exceed 500 ppm. Each delivery shall be accompanied by a guaranteed statement of analysis listing the percent of organic matter and the pH.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 55 percent shall pass through a 0.250 mm sieve. To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 97 percent shall pass through a 0.250 mm sieve.

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 35 percent shall pass through a 0.250 mm sieve.

2.3.2 Fertilizer

Fertilizer for Seed Mix 'A' areas shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. Fertilizer shall be as recommended by a soil test. For bidding purposes, the nutrients ratio shall be 12 percent nitrogen, 4 percent phosphorus, and 8 percent potassium. The fertilizer shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients. Fertilizer for Seed Mix 'C' areas shall be an organic fertilizer composed of 93%-94% fungal or bacterial biomass. The nutrient ratio shall be 6-1-3 or 7-2-3, with at least 70% of the nitrogen available in slow release form. Fertilizer shall be Biosol, Biosol Mix, or approved equal.

2.3.3 Organic Material

Organic material shall consist of either bonemeal, rotted manure, recycled compost, or worm castings.

2.3.3.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.3.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and be free of stones, sticks, and soil.

oil, and toxic substances harmful to plants, and is fully composted or stabilized with nitrogen.

2.3.3.3 Recycled Compost

Compost shall be a well-decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of visible plastic materials.

2.3.3.4 Worm Castings

Worm castings shall be screened from worms and food source, and shall be commercially packaged.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination to meet the requirements of the soil test.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Green sand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized and applied according to the manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide, with an absorption capacity of 250-400 times its weight. Polymers shall also be added to the seed and be a starch grafted polyacrylonitrile, with graphite added as a tacky sticker. It shall have an absorption capacity of 100 plus times its weight.

2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.3.4.5 Expanded Shale, Clay, or Slate (ESCS)

Rotary kiln produced ESCS material shall be in conformance with ASTM D 5883.

2.4 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region.

2.4.1 Wood Cellulose Fiber

Wood cellulose fiber shall not contain any growth or germination-inhibiting factors and shall be dyed an appropriate color to facilitate placement during application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 4.5 to 6.0.

2.5 WATER

Water will be furnished by the Government by the newly installed Whole Barracks Renewal FY03 Project irrigation system(s) and by watering trucks (Seed Mix 'C' areas at Echo Block and all plants for 41st Division Drive). Watering trucks shall be supplied by the Contractor at their expense. Water will be Government-furnished. The point of contact for the locations to fill the watering trucks is Mr. Loren Brown at Ft. Lewis Public Works, (253) 967-4876. Water shall not contain elements toxic to plant life.

2.6 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.7 SURFACE EROSION CONTROL MATERIAL

Surface erosion control material shall conform to the following:

2.7.1 Hydrophilic Colloids (Tackifier)

Hydrophilic colloids shall be physiologically harmless to plant and animal life without phytotoxic agents. Colloids shall be naturally occurring, silicate powder based, and shall form a water insoluble membrane after curing. Colloids shall resist mold growth.

PART 3 EXECUTION

3.1 INSTALLING SEED TIME AND CONDITIONS

3.1.1 Seeding Time

Seed shall be installed from 15 August to 01 October, and from 01 April to 30 June for Echo Block for fall and early spring establishment. Seed shall be installed from 01 September to 01 October, and from 01 April to 15 June for 41st Division Drive for fall and early spring establishment. Seeding shall be installed prior to plant installation for 41st Division Drive.

3.1.2 Seeding Conditions

Seeding operations shall be performed only during periods when beneficial results can be obtained. Seeding operations shall not occur when drought, excessive moisture, excessive heat (above 80 degrees F), cold (below 35 degrees F), or other unsatisfactory conditions prevail. During these conditions notify the Contracting Officer and the work shall be stopped when directed. Late spring or summer seeding is not recommended. When special conditions warrant a variance to the seeding operations, proposed alternate times shall be submitted to Contracting Officer for approval. Even if approved, if the Contractor conducts seeding operations outside the seeding times listed above or under unseasonable conditions, they do so without additional compensation and by accepting FULL responsibility for any subsequent, resulting losses.

3.1.3 Equipment Calibration

Immediately prior to the commencement of seeding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. The calibration test results shall be provided within 1 week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments, including fertilizer, pH adjuster, and soil conditioner, required to meet local growing conditions for the seed species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

The Contractor shall verify that finished grades are as indicated on drawings, and the placing of topsoil, smooth grading, and compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the seeding operation.

Seed Mix 'A' Areas: Prior to placing topsoil over compacted or impermeable soils only, thoroughly till areas to a minimum depth of 150mm by scarifying, disking, harrowing or other approved methods. Spread topsoil evenly to a minimum compacted depth of 150mm in lawn areas. Do not spread topsoil or soil amendment when frozen or excessively wet or dry. Spread organic soil amendment over topsoil evenly to a minimum depth of 50mm in lawn areas. Till topsoil and amendment into loose base soil for a total of 250mm. Remove all rocks over 13mm and provide a smooth, even surface to achieve finish grade. Protect topsoiled areas from damage by vehicular or pedestrian traffic.

Seed Mix 'C' Areas-Echo Block: Areas indicated on the drawings to be seeded, shall be thoroughly tilled to a minimum depth of 50mm by scarifying, disking, harrowing or other approved methods. No topsoil shall be required, except to fill depressions or low spots or to replace other surface materials removed during demolition. Where topsoil may be required, it shall meet the requirements specified herein. Do not spread topsoil or soil amendment when frozen or excessively wet or dry. Topsoil placement shall be smooth, even, and blend to adjacent existing grades.

Seed Mix 'C' Areas-41st Division Drive. The Contractor shall be required to remove Scot's (Scotch) broom (*Cytisus scoparius*) from the site prior to seeding along 41st Division Drive, see Specification 02930. Topsoil shall not be required except in areas shown on drawings where topsoil shall be evenly spread at a compacted depth of 100mm. For areas receiving topsoil, the existing soil shall be thoroughly tilled to a depth of 50mm by scarifying, disking, harrowing or other approved methods. Till topsoil and any required soil amendment into loose base soil for a total of 200mm. Do not spread topsoil or soil amendment when frozen or excessively wet or dry. Topsoil placement shall be smooth, even, and blend to adjacent existing grades. Seeded areas not receiving topsoil shall not be tilled prior to hydroseeding operations.

3.2.2 Application of Soil Amendments

3.2.2.1 Applying pH Adjuster

The pH adjuster shall be applied as recommended by the soil test. The pH adjuster shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage operation.

3.2.2.2 Applying Fertilizer

The fertilizer shall be applied as recommended by the soil test. Fertilizer shall be incorporated into the soil to a maximum 100 mm depth or may be incorporated as part of the tillage or hydroseeding operation.

3.2.2.3 Applying Soil Conditioner

The soil conditioner shall be as recommended by the soil test. The soil conditioner shall be spread uniformly over the soil a minimum 25 mm depth and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.2.4 Applying Super Absorbent Polymers

Polymers shall be spread uniformly over the soil as recommended by the manufacturer and thoroughly incorporated by tillage into the soil to a maximum 100 mm depth.

3.2.3 Tillage

Rototillers shall be used where soil conditions and length of slope permit. Drainage patterns shall be maintained as indicated on drawings. Areas compacted by construction operations shall be completely pulverized by tillage. Soil used for repair of surface erosion or grade deficiencies shall conform to topsoil requirements.

3.2.4 Prepared Surface

3.2.4.1 Preparation

The prepared surface shall be a maximum 13 mm below the adjoining grade of any surfaced area, unless indicated otherwise. New surfaces shall be blended to existing areas. The prepared surface shall be completed with a light raking to remove debris.

3.2.4.2 Lawn Area Debris

Debris and stones over a minimum 13 mm in any dimension shall be removed from the surface of Seed Mix 'A' and sod areas.

3.2.4.4 Protection

Areas with the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing seed, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Seeding operations shall not take place when the wind velocity will prevent uniform seed distribution.

3.3.1 Installing Seed

Seeding method shall be Hydroseeding. Seeding procedure shall ensure even coverage. Absorbent polymer powder shall be mixed with the dry seed at the rate recommended by the manufacturer.

3.3.2 Hydroseeding

Seed mix 'A' shall be mixed to ensure broadcast at the rate of 2.5 kilograms per 100 square meters (5 lb per 1000 s.f.). Seed mix 'C' shall be mixed to ensure broadcast at the rate of 90 kilograms per hectare (80 lb per acre). Seed and fertilizer shall be added to water and thoroughly mixed to meet the rates specified. The time period for the seed to be held in the slurry shall be a maximum 24 hours. Wood cellulose fiber mulch and tackifier shall be added at the rates recommended by the manufacturer after the seed, fertilizer, and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

3.3.3 Mulching

3.3.3.4 Non-Asphaltic Tackifier

Hydrophilic colloid shall be applied at the rate recommended by the manufacturer, using hydraulic equipment suitable for thoroughly mixing with water. A uniform mixture shall be applied over the area.

3.3.3.6 Wood Cellulose Fiber

Wood cellulose fiber shall be applied as part of the hydroseeding operation. The mulch shall be mixed and applied in accordance with the manufacturer's recommendations.

3.3.4 Watering Seed

Watering shall be started immediately after completing the seeding of an area. Water shall be applied to supplement rainfall at a rate sufficient to ensure moist soil conditions to a minimum 25 mm depth. Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.4 SURFACE EROSION CONTROL

3.4.1 Surface Erosion Control Material

Where indicated or as directed, surface erosion control material shall be installed in accordance with manufacturer's instructions. Placement of the material shall be accomplished without damage to installed material or without deviation to finished grade.

3.5 QUANTITY CHECK

For materials provided in bags, the empty bags shall be retained for recording the amount used. For materials provided in bulk, the weight certificates shall be retained as a record of the amount used. The amount of material used shall be compared with the total area covered to determine the rate of application used. Differences between the quantity applied and the quantity specified shall be adjusted as directed.

3.6 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the Installation Pest Management Coordinator.

3.6.1 Technical Representative

The Installation Pest Management Coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. He may be present during treatment application.

3.6.2 Application

A Washington State licensed applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.7 RESTORATION AND CLEAN UP

3.7.1 Restoration

Existing turf areas, plant material, pavements, and facilities that have been damaged from the seeding operation shall be restored to original condition at Contractor's expense.

3.7.2 Clean Up

Excess and waste material shall be removed from the seeded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.8 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the seeding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.9 SEED ESTABLISHMENT PERIOD

3.9.1 Commencement

See 02935 EXTERIOR PLANT MATERIAL MAINTENANCE for turf maintenance requirements. The seed establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end 12 months after the last day of the seeding operation. Written calendar time period shall be furnished for the seed establishment period. When there is more than one seed establishment period, the boundaries of the seeded area covered for each period shall be described. The seed establishment period shall be coordinated with Sections 02922 SODDING and 02930 EXTERIOR PLANTING; AND 02935 EXTERIOR PLANT MATERIAL MAINTENANCE. The seed establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

END OF SECTION

SECTION 02922

SODDING

PART 1 GENERAL

1.1 REFERENCES

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
ASTM D 4972	(1995a) pH of Soils
ASTM D 5268	(1992; R 1996) Topsoil Used for Landscaping Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment;

A listing of equipment to be used for the sodding operation.

Delivery; G

Delivery schedule.

Finished Grade and Topsoil; G

Finished grade status.

Sod Establishment Period; G

Calendar time period for the sod establishment period. When there is more than one sod establishment period, the boundaries of the sodded area covered for each period shall be described.

Maintenance Record; G

Maintenance work performed, area repaired or reinstalled, diagnosis for unsatisfactory stand of grass plants. See also Specification 02935 Exterior Plant Material Maintenance.

Application of Pesticide; G

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; G

Samples taken from several locations at the source.

Soil Amendments; G

A 4.5 kg sample.

SD-06 Test Reports

Equipment Calibration;

Certification of calibration tests conducted on the equipment used in the sodding operation.

Soil Test; G

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Seed; G
Topsoil; G
pH Adjuster;
Fertilizer;
Organic Material;
Soil Conditioner;
Mulch; G
Pesticide; G

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

a. Seed. Classification, botanical name, common name, percent pure live seed, minimum percent germination and hard seed, maximum percent weed seed content, and date tested.

- b. Topsoil. Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Mulch: Composition and source.

1.3 SOURCE INSPECTION

The sources of sod material and delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Sod

Sod shall be protected during delivery to prevent desiccation, internal heat buildup, or contamination.

1.4.1.2 Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.4.2 Inspection

Sod shall be inspected upon arrival at the job site for conformity to species. Sod shall be checked for visible broadleaf weeds, and a visible consistency with no obvious patches of foreign grasses that exceed 2 percent of the canopy. Sod that is heating up, dry, moldy, yellow, irregularly shaped, torn, or of uneven thickness shall be rejected. Topsoil and soil amendments shall meet requirements specified in Spec. Section 02921 Seeding for Seed Mix 'A' areas. Other materials shall be inspected for compliance with specified requirements. Open soil amendment containers or wet soil amendments; topsoil that contains slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 13 mm diameter; and topsoil that contains viable plants and plant parts, shall be rejected. Unacceptable materials shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Sod

Sod shall be stored in designated areas and kept in a moist condition by watering with a fine mist, and covered with moist burlap, straw, or other covering. Covering shall allow air to circulate, preventing internal heat from building up. Sod shall be protected from exposure to wind and direct sunlight until installed.

1.4.3.2 Other Material Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations, away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with sod operation materials.

1.4.4 Handling

Sod shall not be damaged during handling. Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

1.4.5 Time Limitation

Time limitation between harvesting and installing sod shall be a maximum 36 hours.

PART 2 PRODUCTS

2.1 SOD

2.1.1 Sod Classification

Nursery-grown sod shall be provided as classified by applicable state laws. Sod section shall be sized to permit rolling and lifting without breaking.

2.1.2 Grass Species

Grass species shall be proportioned as follows:

Botanical Name	Common Name	Mixture Percent
Lolium perenne	Turf-type perennial ryegrass	50%
Festuca rubra	Creeping red or Chewings Fescue	50%

2.1.3 Quality

Sod shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 13 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the sod section. Sod shall contain no annual ryegrass, bluegrass, or bentgrass species. Sod shall be free of restricted and prohibited noxious weeds.

2.1.4 Thickness

Sod shall be machine cut to a minimum 35 mm thickness. Measurement for thickness shall exclude top growth and thatch.

2.1.5 Anchors

Sod anchors shall be as recommended by the sod supplier.

2.1.6 Substitutions

Substitutions will not be allowed without written request and approval from the Contracting Officer.

2.2 TOPSOIL

Topsoil and all soil preparation and finish grading shall be as defined in Specification SECTION: 02921 SEEDING, Seed Mix 'A' Areas.

2.3 FERTILIZER

It shall be as recommended by the soil test. For bidding purposes, the nutrients ratio shall be 12 percent nitrogen, 4 percent phosphorus, and 8 percent potassium. Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The fertilizer shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.4 WATER

Water will be furnished by the Government by the newly installed Whole Barracks Renewal FY03 Project irrigation system(s) and by watering trucks (Seed Mix 'C' areas at Echo Block and all plants for 41st Division Drive). Watering trucks shall be supplied by the Contractor at their expense. Water will be Government furnished. The point of contact for the locations to fill the watering trucks is Mr. Loren Brown at Ft. Lewis Public Works, (253) 967-4876. Water shall not contain elements toxic to plant life.

2.5 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

PART 3 EXECUTION

3.1 INSTALLING SOD TIME AND CONDITIONS

3.1.1 Sodding Time

Sod shall be installed from 15 April to 15 June for spring establishment; from 15 September to 1 November for fall establishment.

3.1.2 Sodding Conditions

Sodding operations shall be performed only during periods when beneficial results can be obtained. Sodding operations shall not occur when drought, excessive moisture, excessive heat (above 80 degrees F), cold (below 35 degrees F), or other unsatisfactory conditions prevail. During these conditions notify the Contracting Officer and the work shall be stopped when directed. When special conditions warrant a variance to the sodding operations, proposed alternate times shall be submitted to Contracting Officer for approval. Even if approved, if the Contractor conducts sodding operations outside the seeding times listed above or under unseasonable conditions, they do so without additional compensation and by accepting FULL responsibility for any subsequent, resulting losses.

3.1.3 Equipment Calibration

Immediately prior to the commencement of sodding operations, calibration tests shall be conducted on the equipment to be used. These tests shall confirm that the equipment is operating within the manufacturer's specifications and will meet the specified criteria. The equipment shall be calibrated a minimum of once every day during the operation. Provide calibration test results within one week of testing.

3.1.4 Soil Test

Delivered topsoil, existing soil in smooth graded areas, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection on site shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the sod species specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade and Topsoil

Prior to the commencement of the sodding operation, the Contractor shall verify that finished grades are as indicated on drawings. Application of topsoil, soil amendments and tillage shall be as indicated in Section 02921 Seeding, Seed Mix 'A' areas.

3.2.2 Protection

Areas within the prepared surface shall be protected from compaction or damage by vehicular or pedestrian traffic and surface erosion.

3.3 INSTALLATION

Prior to installing sod, any previously prepared surface compacted or damaged shall be reworked to meet the requirements of paragraph SITE PREPARATION. Areas shall be sodded as indicated. Adequate soil moisture shall be ensured prior to sodding by spraying water on the area to be sodded and wetting the soil to a maximum 25 mm depth.

3.3.1 Installing Sod

Rows of sod sections shall be placed parallel to and tightly against each other. Joints shall be staggered laterally. The sod sections shall not be stretched or overlapped. All joints shall be butted tight. Voids and air drying of roots shall be prevented. Sod sections shall be laid across the slope on long slopes. Sod sections shall be laid at right angles to the flow of water in ditches. Sod sections shall be anchored on slopes steeper than 3-horizontal-to-1-vertical. Anchoring may be required when surface weight or pressure upon placed sod sections is anticipated to cause lateral movement. Sod anchors shall be placed a minimum 600 mm on center with a minimum 2 anchors per sod section.

3.3.2 Finishing

Displacement of the sod shall be prevented by tamping or rolling the sod in place and knitting the sod to the soil. Air pockets shall be eliminated and a true and even surface shall be provided. Frayed edges shall be trimmed, and holes or missing corners shall be patched with sod.

3.3.3 Rolling

The entire area shall be firmed with a roller not exceeding 130 kilograms per meter roller width. Slopes over a maximum 3-horizontal-to-1 vertical shall not be rolled.

3.3.4 Watering Sod

Watering shall be started immediately after completing each day of installing sod. Water shall be applied at least 3 times per week to supplement rainfall, at a rate sufficient to ensure moist soil conditions to a minimum depth of 25 mm. Run-off, puddling, and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or plant material shall be prevented.

3.4 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the Installation Pest Management Coordinator.

3.4.1 Technical Representative

The Installation Pest Management Coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. He may be present during treatment application.

3.4.2 Application

A Washington State licensed applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.5 RESTORATION AND CLEAN UP

3.5.1 Restoration

Existing turf areas, plant beds, pavements, and facilities that have been damaged from the sodding operation shall be restored to original condition at Contractor's expense.

3.5.2 Clean Up

Excess and waste material shall be removed from the sodded areas and shall be disposed offsite. Adjacent paved areas shall be cleaned.

3.6 PROTECTION OF INSTALLED AREAS

Immediately upon completion of the sodding operation in an area, the area shall be protected against traffic or other use by erecting barricades and providing signage as required, or as directed.

3.7 SOD ESTABLISHMENT PERIOD

3.7.1 Commencement

See 02935 EXTERIOR PLANT MATERIAL MAINTENANCE for detailed sod maintenance requirements. The sod establishment period to obtain a healthy stand of grass plants shall begin on the first day of work under this contract and shall end 12 months after the last day of sodding operation. Written calendar time period shall be furnished for the sod establishment period. When there is more than 1 sod establishment period, the boundaries of the sodded area covered for each period shall be described. The sod establishment period should be coordinated with Sections 02921 SEEDING, 02930 EXTERIOR PLANTING, and 02935 EXTERIOR PLANT MATERIAL MAINTENANCE. The sod establishment period shall be modified for inclement weather, shut down periods, or for separate completion dates of areas.

3.7.2 Satisfactory Stand of Grass Plants

Grass plants shall be evaluated for species and health. A satisfactory stand of grass plants from the sodding operation shall be living sod uniform in color and leaf texture. Bare spots shall be a maximum 50 mm square. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

3.7.3 Maintenance Prior to the Commencement of the Plant Establishment Period

Maintenance of the sodded areas shall include eradicating weeds, insects and diseases; protecting embankments and ditches from surface erosion; maintaining erosion control materials and mulch; protecting installed areas from traffic; mowing; watering; and post-fertilization.

3.7.3.1 Mowing

Sodded areas shall be mowed to a minimum 75 mm height when the turf is a maximum 100 mm height. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.7.3.2 Post-Fertilization

The fertilizer shall be applied as recommended by the soil test. A maximum 4 kilograms per hectare of actual available nitrogen shall be provided to the grass plants. The application shall be timed prior to the advent of winter dormancy and shall be made without burning the installed grass plants.

3.7.3.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.7.3.4 Repair

Unsatisfactory stand of grass plants shall be repaired or reinstalled, and eroded areas shall be repaired in accordance with paragraph SITE PREPARATION.

3.7.3.5 Maintenance Record

A record of each site visit shall be furnished which describes the maintenance work performed; areas repaired or reinstalled; and diagnosis for unsatisfactory stand of grass plants.

END OF SECTION

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SECTION 02930

EXTERIOR PLANTING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NURSERY AND LANDSCAPE ASSOCIATION (ANLA)

ANLA Z60.1 (1996) Nursery Stock

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300 (1995) Tree Care Operations - Trees, Shrubs and other Woody Plant Maintenance

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602 (1995a) Agricultural Liming Materials

ASTM D 4972 (1995a) pH of Soils

ASTM D 5034 (1995) Breaking Strength and Elongation of Textile Fabrics (Grab Test)

ASTM D 5035 (1995) Breaking Force and Elongation of Textile Fabrics (Strip Method)

ASTM D 5268 (1992; R 1996) Topsoil Used for Landscaping Purposes

ASTM D 5883 (1996e1) Use of Rotary Kiln Produced Expanded Shale, Clay or Slate (ESCS) as a Mineral Amendment in Topsoil Used for Landscaping and Related Purposes

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Geotextile;
Chemical Treatment Material;

Manufacturer's literature including physical characteristics, application and installation instructions for geotextile and chemical treatment material.

Equipment;

A listing of equipment to be used for the planting operation.

Delivery;

Delivery schedule. G

Work Plan and Schedule ; G

Maintenance Record; G

Maintenance work performed, quantity of plant losses, and replacements; and diagnosis of unhealthy plant material for period prior to 1-year Plant Establishment Period. See Section 02935 Exterior Plant Material Maintenance.

Application of Pesticide; G

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-04 Samples

Delivered Topsoil; G

Samples taken from several locations at the source.

Soil Amendments; G

A 4.5 kg sample.

Mulch; G

A 4.5 kg sample.

Geotextile;

A 150 mm square sample.

Large Landscape Rock;

Representative sample provided from source to be used.

SD-06 Test Reports

Soil Test; G
Percolation Test; G

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Plant Material; G
Topsoil; G
pH Adjuster;
Fertilizer;
Organic Material;
Soil Conditioner;
Organic Mulch; G
Pesticide; G
Large Landscape Rock; G

Prior to delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following.

- a. Plant Material: Classification, botanical name, common name, size, quantity by species, and location where grown.
- b. Topsoil: Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster: Sieve analysis and calcium carbonate equivalent.
- d. Fertilizer: Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Soil Conditioner: Composition and source.
- g. Organic Mulch: Composition, source, and treatment against fungi growth.
- h. Pesticide. EPA registration number and registered uses.
- i. Large Landscape Rock: Composition, sizes available, and source.

1.3 SOURCE INSPECTIONS

The nursery or source of plant material and the source of delivered topsoil shall be subject to inspection.

1.4 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.4.1 Delivery

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.4.1.1 Plant Material Identification

Plant material shall be identified with attached, durable, waterproof labels and weather-resistant ink, stating the correct botanical and common plant name and size.

1.4.1.2 Protection During Delivery

Plant material shall be protected during delivery to prevent desiccation and damage to the branches, trunk, root system, or earth ball. Branches shall be protected by tying-in. Exposed branches shall be covered during transport.

1.4.1.3 Delivered Topsoil

Prior to the delivery of any topsoil, the availability of topsoil shall be verified in paragraph TOPSOIL. A soil test shall be provided for delivered topsoil.

1.4.1.4 Soil Amendments

Soil amendments shall be delivered to the site in the original, unopened containers bearing the manufacturer's chemical analysis. In lieu of containers, soil amendments may be furnished in bulk. A chemical analysis shall be provided for bulk deliveries.

1.4.1.5 Pesticide Material

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the Environmental Protection Agency (EPA) registration number and the manufacturer's registered uses.

1.4.2 Inspection

Plant material shall be well shaped, vigorous and healthy with a healthy, well branched root system, free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement or abrasion. Plant material shall be checked for unauthorized substitution and to establish nursery grown status. Plant material showing desiccation, abrasion, sun-scald injury, disfigurement, or unauthorized substitution shall be rejected. The plant material shall exhibit typical form of branch to height ratio; and meet the caliper and height measurements specified. Plant material that measures less than specified, or has been poled, topped off or headed back, shall be rejected. Container-grown plant material shall show new fibrous roots and the root mass shall contain its shape when removed from the container. Plant material with broken or cracked balls; or broken containers shall be rejected. Bare-root plant material that is not dormant or is showing roots were pulled from the ground shall be rejected. Other materials shall be inspected for compliance with paragraph PRODUCTS. Open soil amendment containers or wet soil amendments shall be rejected. Topsoil that contains slag,

cinders, stones, lumps of soil, sticks, roots, trash or other material larger than 40 mm diameter shall be rejected. Topsoil that contains viable plant material and plant parts shall be rejected. Unacceptable material shall be removed from the job site.

1.4.3 Storage

1.4.3.1 Plant Material Storage

Plant material not installed on the day of arrival at the site shall be stored and protected in designated areas. Plant material shall not be stored longer than 30 days. Plant material shall be protected from direct exposure to wind and sun. Bare-root plant material shall be heeled-in. All plant material shall be kept in a moist condition by watering with a fine mist spray until installed.

1.4.3.2 Other Material Storage

Storage of other material shall be in designated areas. Soil amendments shall be stored in dry locations and away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with planting operation material.

1.4.4 Handling

Plant material shall not be injured in handling. Cracking or breaking the earth ball of balled and burlapped plant material shall be avoided. Plant material shall not be handled by the trunk or stems. Materials shall not be dropped from vehicles.

1.4.5 Time Limitation

Except for container-grown plant material, the time limitation from digging to installing plant material shall be a maximum 90 days. The time limitation between installing the plant material and placing the mulch shall be a maximum 24 hours.

1.5 WARRANTY

Furnished plant material shall have a warranty or guarantee for plant growth to be in a vigorous growing condition for a minimum 12-month period from final completion. A minimum 12-month calendar time period for the warranty of plant growth shall be provided regardless of the contract time period. When plant material is determined to be unhealthy in accordance with paragraph PLANT ESTABLISHMENT PERIOD, it shall be replaced once under this warranty.

PART 2 PRODUCTS

2.1 PLANT MATERIAL

2.1.1 Plant Material Classification

The plant material shall be nursery grown stock conforming to ANLA Z60.1 and shall be the species specified.

2.1.2 Plant Schedule

The plant schedule shall provide botanical names as included in one or more of the publications listed under "Nomenclature" in ANLA Z60.1.

2.1.3 Substitutions

Substitutions will not be permitted without written request and approval from the Contracting Officer.

2.1.4 Quality

Well-shaped, well grown, vigorous plant material having healthy and well branched root systems in accordance with ANLA Z60.1 shall be provided. Plant material shall be provided free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems, which may occur from the digging and preparation for shipment, method of shipment, or shipment. Plant quality is determined by the growing conditions; method of shipment to maintain health of the root system; and growth of the trunk and crown as follows.

2.1.5 Growing Conditions

Plant material shall be native to or well-suited to the growing conditions of the project site. Plant material shall be grown under climatic conditions similar to those at the project site.

2.1.6 Method of Shipment to Maintain Health of Root System

2.1.6.1 Balled and Burlapped (BB) Plant Material

Ball size and ratio shall be in accordance with ANLA Z60.1. The ball shall be of a diameter and depth to encompass enough fibrous and feeding root system necessary for the full recovery of the plant. The plant stem or trunk shall be centered in the ball. All roots shall be clean cut at the ball surface. Roots shall not be pulled from the ground. The root ball shall be completely wrapped with burlap or other suitable material and securely laced with biodegradable twine.

2.1.6.2 Container-Grown (C) Plant Material

Container size shall be in accordance with ANLA Z60.1. Plant material shall be grown in a container over a duration of time for new fibrous roots to have developed and for the root mass to retain its shape and hold together when removed from the container. Container-grown plant material shall be inoculated with mycorrhizal fungi during germination in the nursery. The container shall be sufficiently rigid to hold ball shape and protect root mass during shipping.

2.1.6.3 Bare-Root (BR) Plant Material

Minimum root spread shall be in accordance with ANLA Z60.1. A well-branched root system characteristic of the species specified shall be provided. Roots shall not be pulled from the ground. Bare-root plant material shall be dormant. The root system shall be protected from drying out.

2.1.7 Growth of Trunk and Crown

2.1.7.1 Deciduous Trees

A height to caliper relationship shall be provided in accordance with ANLA Z60.1. Height of branching shall bear a relationship to the size and species of tree specified and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: All countable stems, in aggregate, shall average the size specified. To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.
- c. Specimen: The tree provided shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be as indicated.

2.1.7.2 Deciduous Shrubs

Deciduous shrubs shall have the height and number of primary stems recommended by ANLA Z60.1. Acceptable plant material shall be well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the project.

2.1.7.3 Coniferous Evergreen Plant Material

Coniferous Evergreen plant material shall have the height-to-spread ratio recommended by ANLA Z60.1. The coniferous evergreen trees shall not be "poled" or the leader removed. Acceptable plant material shall be exceptionally heavy, well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be as indicated.

2.1.7.4 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material shall have the height-to-spread ratio recommended by ANLA Z60.1. Acceptable plant material shall be well shaped and recognized by the trade as typical for the variety grown in the region of the project.

2.1.7.5 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall have the minimum number of runners and length of runner recommended by ANLA Z60.1. Plant material shall have heavy, well developed and balanced crown with vigorous, well developed root system and shall be furnished in containers.

2.1.8 Plant Material Size

Plant material shall be furnished in sizes indicated. Plant material larger in size than specified may be provided at no additional cost to the Government.

2.1.9 Plant Material Measurement

Plant material measurements shall be in accordance with ANLA Z60.1.

2.2 TOPSOIL

Topsoil shall be as defined in ASTM D 5268. Topsoil shall be delivered and amended as recommended by the soil test to meet the topsoil requirement specified in SECTION 02921: Seeding. Topsoil shall be free from slag, cinders, stones, lumps of soil, sticks, roots, trash or other material over a minimum 40 mm diameter. Topsoil shall be free from viable plants and plant parts.

2.2.1 Soil Test

A soil test shall be performed for pH, organic matter content, textural class, particle size, chemical analysis and soluble salts to establish the quantities and type of soil amendments required to meet local growing conditions for the type and variety of plants specified.

2.3 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite is not recommended.

2.3.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified.

2.3.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve (No. 8) and a minimum 55 percent shall pass through a 0.25 mm sieve (No. 60). To raise soil pH, ground limestone shall be used.

2.3.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm sieve (No. 8) and a minimum 97 percent shall pass through a 0.25 mm sieve (No. 60).

2.3.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm sieve (No. 8) and a minimum 35 percent shall pass through a 0.25 mm sieve (No. 60).

2.3.2 Fertilizer

The nutrient ratio shall be 20 percent nitrogen, 10 percent phosphorus, and 5 percent potassium. Fertilizer shall be controlled release commercial grade; free flowing, pellet or tablet form; uniform in composition. The fertilizer shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.3.3 Organic Material

Organic material shall consist of either bonemeal, rotted manure, , recycled compost, or worm castings.

2.3.3.1 Bonemeal

Bonemeal shall be a finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.3.3.2 Rotted Manure

Rotted manure shall be unleached horse, chicken, or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. Manure shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds and shall be free of stones, sticks, and soil.

2.3.3.3 Recycled Compost

Compost shall be a well decomposed, stable, weed free organic matter source. It shall be derived from food, agricultural, or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent or less by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length.

2.3.3.4 Worm Castings

Worm castings shall be screened from worms and food source and shall be commercially packaged.

2.3.4 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for single use or in combination to meet topsoil requirements for the plant material specified.

2.3.4.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Green sand shall be balanced with the inclusion of trace minerals and nutrients.

2.3.4.2 Super Absorbent Polymers

To improve water retention in soils, super absorbent polymers shall be sized according to manufacturer's recommendations. Polymers shall be added as a soil amendment and be cross-linked polyacrylamide with an absorption capacity of 250-400 times its weight.

2.3.4.4 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.4 LANDSCAPE EDGING

2.4.1 ECHO BLOCK

- a. For hand-tooled edging, see detail plate L501.
- b. Concrete mow edging shall be 150mm wide by 300mm deep for planting beds. For mow edges along the perimeter of buildings, concrete shall be minimum 300mm wide. Concrete edging shall be fiberglass reinforced. Edging shall have expansion joints of 13mm premolded filler at 6M O.C. and a 6mm radius on top edges. Expansion joints shall be provided where concrete mow edge abuts other concrete structures.
- c. Metal edging shall be 4.8mm thick and 140mm wide 100% recycled aluminum edging manufactured specifically as a landscape edging or border material. Lengths shall be minimum 2.4M or as provided by manufacturer. Edging shall be straight or 'L' shaped and have locking edges that overlap and allow anchoring stakes to be installed at regular intervals. Anchor stakes shall be steel and be supplied by same manufacturer as metal edging. Edging finish shall be black. Metal edging shall be Duralum; Permaloc; Sure-loc; or approved equal.

2.5 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure is not recommended to be used as a mulch because it would encourage surface rooting of the plant material and weeds.

2.5.1 Inorganic Mulch

When inorganic mulch is required for decorative purposes, it shall be provided in areas designated, and consist of riverbank stone ranging in size from 25mm to 50 mm.

2.5.2 Organic Mulch

Organic mulch materials shall be shredded or ground fir or hemlock bark manufactured specifically for landscape use.

2.5.2.1 Shredded or Ground Bark

Locally shredded or ground material shall be treated to retard the growth of mold and fungi.

2.5.2.2 Shredded or Ground Bark

Locally shredded or ground material shall be 25mm to 50mm in size.

2.6 LARGE LANDSCAPE ROCK

Large landscape rock shall be locally available (within 4 hours drive), naturally-occurring shaped landscape rock between two and four-man rocks, or as indicated on the drawings. Rocks shall have earth tone colors consisting of grays, light browns, and tan. Landscape rocks shall be similar to that locally found in naturally-occurring outcroppings. Large landscape rock shall be weathered basalt by Interstate Rock Products, Inc. or approved equal.

2.7 GEOTEXTILE (Weed Barrier Fabric)

Geotextile shall be nonwoven; 100% polypropylene mat in accordance with ASTM D 5034 or ASTM D 5035. It shall be made specifically for use as a commercial-grade, landscape fabric around plant material. Nominal weight shall be a minimum 120 grams per square meter. Permeability rate shall be a minimum 1 mm per second. Geotextile shall be used with concrete pavers & rock mulch areas as shown in plans and details.

2.8 STAKING AND GUYING OF TREES

Staking and guying of trees shall not be required for this project because staking can impede normal tree growth and may lead to a weaker trunk, see paragraph UNHEALTHY PLANT MATERIAL. Tree staking and guying will be allowed only upon approval by the Contracting Officer Representative. Tree staking and guying approved for use must be removed at the end of the 12-month plant establishment period, see Spec. Section 02935 Exterior Plant Material Maintenance.

2.9 WATER

Water will be furnished by the Government by the newly installed Whole Barracks Renewal FY03 Project irrigation system(s) and by watering trucks (Seed Mix 'C' areas at Echo Block and all plants for 41st Division Drive). Watering trucks shall be supplied by the Contractor at their expense. Water will be Government furnished. The point of contact for the locations to fill the watering trucks is Mr. Loren Brown at Ft. Lewis Public Works, (253) 967-4876. Water shall not contain elements toxic to plant life.

2.10 PESTICIDE

Pesticide shall be insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

PART 3 EXECUTION

3.1 INSTALLING PLANT MATERIAL TIME AND CONDITIONS

3.1.1 Plant Material Conditions

Planting operations shall be performed only during periods when beneficial results can be obtained. Summer planting shall be avoided. Planting shall occur between 01 September and 31 May for Echo Block. For 41st Division Drive, planting, with the exception of bare root plants, shall occur between 15 September and 15 May. Bare root planting shall occur between 01 December and 30 April. Planting shall not occur when drought, excessive moisture, excessive heat (above 80 degrees F), cold (below 35 degrees F), frozen ground or other unsatisfactory, or extreme conditions prevail. During these conditions notify the Contracting Officer and the work shall be stopped when directed. When special conditions warrant a variance to the planting operations, proposed planting times shall be submitted to the Contracting Officer for approval. Even if approved, if the Contractor conducts planting operations outside the planting periods listed above or under unseasonable conditions, they do so without additional compensation and by accepting FULL responsibility for any subsequent, resulting losses.

3.1.2 Tests

3.1.2.1 Percolation Test

Test for percolation shall be done to determine positive drainage of plant pits and beds. A positive percolation shall consist of a minimum 25 mm per 3 hours; when a negative percolation test occurs, a shop drawing shall be submitted indicating the corrective measures.

3.1.2.2 Soil Test

Delivered topsoil, excavated plant pit soil, and stockpiled topsoil shall be tested in accordance with ASTM D 5268 and ASTM D 4972 for determining the particle size, pH, organic matter content, textural class, chemical analysis, soluble salts analysis, and mechanical analysis. Sample collection onsite shall be random over the entire site. Sample collection for stockpiled topsoil shall be at different levels in the stockpile. The soil shall be free from debris, noxious weeds, toxic substances, or other materials harmful to plant growth. The test shall determine the quantities and type of soil amendments required to meet local growing conditions for the plant material specified.

3.2 SITE PREPARATION

3.2.1 Finished Grade, Topsoil and Underground Utilities

The Contractor shall verify that finished grades are as indicated on drawings, and that the placing of topsoil, the smooth grading, and the compaction requirements have been completed in accordance with Section 02300 EARTHWORK, prior to the commencement of the planting operation. The location of underground utilities and facilities in the area of the planting operation shall be verified. Damage to underground utilities and facilities shall be repaired at the Contractor's expense. For 41st Division Drive for planting areas that require topsoil, see Seeding Specification 02921 paragraph 3.2 Site Preparation.

3.2.2 Layout

Plant material locations and bed outlines shall be staked on the project site before any excavation is made. Plant material and bed locations may be adjusted to meet field conditions, upon approval by the Contracting Officer.

3.2.3 Protecting Existing Vegetation

When there are established lawns in the planting area, the turf shall be covered and/or protected during planting operations. Existing trees, shrubs, and plant beds that are to be preserved shall be barricaded with construction fencing or equal along the dripline to protect them during planting operations. See Specification 02220 Demolition, 1.5.5 Tree Protection and 01410 Environmental Protection, 3.4.4. Tree Protection.

3.2.4 Preparing Existing Vegetation at Echo Block

Existing trees to be preserved in Echo Block shall be crown-pruned to remove all dead, broken, or crossing branches within the crown of the tree. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. Trees to remain shall also have all flagging, paint, hardware, or other man-made products removed prior to new exterior plant material installation.

3.2.5 Installing Large Landscape Rock

Large landscape rock shall be installed where indicated on the drawings. Placement shall be to mimic locally found, naturally-occurring outcroppings. Rocks shall be buried at least 1/3 of the total height. Rocks placed within 10M of building perimeters shall not exceed 150mm in height above finish grade after installation. Spacing between individual rocks within an outcropping (grouping of 3-5 rocks) shall randomly vary between 150mm and 450mm and shall facilitate installation of plant materials as indicated on the drawings. Final rock placement shall be approved by the Contracting Officer.

3.2.6 Landscape Edging

3.2.6.1 Echo Block

- a. Landscape edging shall be provided around all individual trees in lawn areas and shall consist of hand-tooled edging in a 1.2M diameter circle to create a clear definition between turf areas and planted/mulched areas. For groups of trees in lawn areas, hand-tooled edging shall be provided between mulch bed and turf as shown on drawings.
- b. Concrete mow edge shall be installed between lawn and plant beds and where otherwise indicated on the drawings. Concrete mow edge shall be installed as detailed on the drawings. Finish grade of the mow edge shall be installed approx. 13mm above finish grade of the grass areas to facilitate mowing. Top of mow edge shall give a smooth, even appearance free from noticeable elevation changes.
- c. Metal edging shall be provided as a divider between different types of groundcovers and where indicated on the drawings. Metal edging shall be installed in accordance with the manufacturer's recommendations. Edging shall be installed a maximum of 13mm above surface of material on each side.

3.2.6.2 41ST Division Drive

- a. Hand-tooled edging shall be provided between plant beds and seeded areas in medians only as indicated on drawings. No other edging shall be used.

3.2.7 Pre-emergent Herbicide

A pre-emergent herbicide shall be applied to all planting beds prior to plant material installation.

3.3 EXCAVATION

3.3.1 Obstructions Below Ground

When obstructions below ground affect the work, shop drawings showing proposed adjustments to plant material location, type of plant and planting method shall be submitted for approval.

3.3.2 Turf Removal

Where the planting operation occurs in an existing lawn area, the turf shall be removed from the excavation area to a depth that will ensure the removal of the entire root system.

3.3.3 Removal of Scot's (Scotch) Broom on 41ST Division Drive

The contractor shall be required to remove Scot's (Scotch) broom (*Cytisus scoparius*) from the site prior to installing new plants or seeding. Scot's broom shall be removed down to ground level or pulled up: no herbicides shall be used for removal. If plant installation occurs in the fall, Scot's broom shall be removed prior to 1 July in order to kill and remove plants before their seed ripening period. Plant material shall be removed off site at the Contractor's expense.

3.3.3 Plant Pits

Plant pits for ball and burlapped or container plant material shall be dug to a depth equal to the height of the root ball as measured from the base of the ball to the base of the plant trunk. Plant pits for bare-root plant material shall be dug to a depth equal to the height of the root system. Plant pits shall be dug a minimum 150 mm wider than the ball or root system to allow for root expansion.

3.4 INSTALLATION

3.4.1 Setting Plant Material

Plant material shall be set plumb and held in position until sufficient soil has been firmly placed around root system or ball. In relation to the surrounding grade, the plant material shall be set even with the grade at which it was grown.

3.4.2 Bare-root Plant Material

Bare-root plant material shall be placed in water a minimum 30 minutes prior to setting.

3.4.3 Backfill Soil Mixture

3.4.3.1 Backfill Soil Mixture for Trees

Echo Block:

The backfill soil mixture shall be a proportioned mixture thoroughly mixed as follows: Existing excavated soil = 2 parts to mixture; Amended topsoil = 1 part to mixture. Amended topsoil shall be as specified in Specification SECTION 02921: SEEDING. In planting beds where trees are planted together with shrubs and ground covers, use backfill soil mixture requirements for shrubs, ground covers, and vines.

41st Division Drive:

Backfill soil mixture for 41st Division Drive project trees shall be existing excavated soil.

3.4.3.2 Backfill Soil Mixture for Shrubs, Ground covers and Vines

Echo Block:

The backfill soil mixture shall be a proportioned mixture thoroughly mixed as follows: Existing excavated soil = 1 part to mixture; Amended topsoil = 2 parts to mixture. Amended topsoil shall be as specified in Specification SECTION 02921: SEEDING.

41st Division Drive:

Backfill soil mixture shall be a proportioned mixture thoroughly mixed as follows: Existing excavated soil = 1 part to mixture; Amended topsoil = 2 parts to mixture. For planting areas shown on drawings where 100mm of topsoil is added to entire area, backfill soil mixture shall be existing excavated soil. Amended topsoil shall be as specified in Specification SECTION 02921: SEEDING.

3.4.4 Backfill Procedure

Prior to backfilling, all metal, wood, synthetic products, or treated burlap devices shall be removed from the ball or root system avoiding damage to the root system. The backfill procedure shall remove air pockets from around the root system. Controlled-release fertilizer shall be placed in packet or tablet form in the plant pit in the immediate vicinity of the feeding roots in accordance with the manufacturer's recommendations. Granular fertilizer shall be mixed thoroughly with the planting soil mix during installation.

3.4.4.1 Balled and Burlapped Plant Material

Biodegradable burlap and tying material shall be carefully opened and folded back from the top a minimum 1/2 depth from the top of the root ball. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped. After plant is set, cut and remove the top 1/2 of the burlap material and remove all twine.

3.4.4.2 Bare-Root Plant Material

The root system shall be spread out and arranged in its natural position. Damaged roots shall be removed with a clean cut. The backfill soil mixture shall be carefully worked in amongst the roots and watered to form a soupy mixture. Air pockets shall be removed from around the root system, and root to soil contact shall be provided.

3.4.4.3 Container-Grown and Balled and Potted Plant Material

The plant material shall be carefully removed from containers that are not biodegradable. Prior to setting the plant in the pit, a maximum 1/4 depth of the root mass, measured from the bottom, shall be spread apart to promote new root growth. For plant material in biodegradable containers the container shall be split prior to setting the plant with container. Backfill mixture shall be added to the plant pit in 150 mm layers with each layer tamped.

3.4.4.4 Earth Berm

An earth berm, consisting of backfill soil mixture in lawn areas or bark mulch in planting areas, shall be formed with a minimum 100 mm height around the edge of the plant pit to aid in water retention and to provide soil for settling adjustments.

3.4.5 Plant Bed

Plant material shall be set in plant beds according to the drawings. Backfill soil mixture shall be placed on previously scarified subsoil to completely surround the root balls, and shall be brought to a smooth and even surface, blending to existing areas. Earth berms shall be provided. Polymers shall be spread uniformly over the plant bed and in the planting pit as recommended by the manufacturer and thoroughly incorporated into the soil to a maximum 100 mm depth.

3.4.6 Watering

Plant pits and plant beds shall be watered immediately after backfilling, until completely saturated.

3.4.7 Edging Plant Beds or Individual Plants

Echo Block:

Individual trees in lawn areas shall have a mulched bed, circular in shape (1.2 M minimum diameter). All edges of tree circles shall be uniformly edged (hand-tooled edge) using a sharp tool to provide a clear-cut division line between the planted area and adjacent lawn.

Plant beds shall be edged as indicated on the plans. Concrete mowing edge shall be provided between lawn and planted areas. See drawings for concrete mow edge detail. Other edging shall be provided as indicated on the drawings.

41st Division Drive:

Edging shall only be used in medians between turf areas and trees, and between turf areas and plant beds. Trees in medians shall have a mulched bed, circular in shape (1.2 M minimum diameter). All edges of tree circles and plant beds shall be uniformly edged (hand-tooled edge) using a sharp tool to provide a clear-cut division line between the planted area and adjacent turf.

3.5 FINISHING

3.5.1 Plant Material

Prior to placing mulch, the installed area shall be uniformly edged to provide a clear division line between the planted area and the adjacent turf area, shaped as indicated. The installed area shall be raked and smoothed while maintaining the earth berms.

3.5.2 Placing Geotextile (Weed Barrier Fabric)

Prior to placing rock mulch or sand bedding, geotextile shall be placed as indicated in accordance with the manufacturer's recommendations.

3.5.3 Placing Mulch

The placement of mulch shall occur a maximum 48 hours after planting. Organic mulch, used to reduce soil water loss, regulate soil temperature and prevent weed growth, shall be spread to cover the installed area with a minimum 75mm uniform thickness for trees, shrubs, and larger groundcovers or 38mm uniform thickness for smaller groundcovers as indicated on the drawings. Rock mulch shall be placed to a minimum thickness of 100mm. Mulch shall be kept out of the crowns of shrubs, ground cover, and vines and shall be kept off buildings, sidewalks and other facilities. Mulch must not be placed with 100mm of the trunks of trees or shrubs.

3.5.4 Pruning

Pruning shall be accomplished by trained and experienced personnel. The pruning of trees shall be in accordance with ANSI A300. Only dead, diseased, or broken material shall be pruned from installed plants. The typical growth habit of individual plant material shall be retained. Limbs and branches to be pruned shall be neatly cut just outside the branch collar parallel with the trunk or adjacent larger branch; do not leave stubs. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.6 MAINTENANCE DURING PLANTING OPERATION

Installed plant material shall be maintained in a healthy growing condition. Maintenance operations shall begin immediately after each plant is installed to prevent desiccation and shall continue until the plant establishment period commences. Installed areas shall be kept free of weeds, grass, and other undesired vegetation. The maintenance includes maintaining the mulch, watering, straightening plants, and adjusting/settling.

3.7 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the installation pest management program.

3.7.1 Technical Representative

The certified installation pest management coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control. They may be present during treatment application.

3.7.2 Application

A state certified applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended as it prevents the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.8 RESTORATION AND CLEAN UP

3.8.1 Restoration

Turf areas, pavements and facilities that have been damaged from the planting operation shall be restored to original condition at the Contractor's expense.

3.8.2 Clean Up

Excess and waste material shall be removed from the installed area and shall be disposed offsite. Adjacent paved areas shall be cleared.

3.9 PLANT ESTABLISHMENT PERIOD

3.9.1 Commencement

Maintenance of the exterior plant materials is required during a 12-month Plant Establishment Period shall be provided by the Contractor in accordance with Specification 02935 Exterior Plant Material Maintenance.

3.9.2 Maintenance Required PRIOR to Commencement of the Plant Establishment Period

The purpose of the maintenance requirements herein are to be in effect from the time plants are installed until the beginning of the plant establishment period. Maintenance of plant material shall include straightening plant material; tightening guying material (only if staking is approved by CO); correcting girdling; supplementing mulch; pruning dead or broken branch tips; maintaining plant material labels; watering; eradicating weeds, insects and disease; post-fertilization; and removing and replacing unhealthy plants.

3.9.2.1 Watering Plant Material

The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone. An adequate supply of moisture is

estimated to be the equivalent of 25 mm absorbed water per week, delivered in the form of rain or augmented by watering. Run-off, puddling and wilting shall be prevented. Unless otherwise directed, watering trucks shall not be driven over turf areas. Watering of other adjacent areas or existing plant material shall be prevented.

3.9.2.2 Weeding

Voluntary grass and weeds in the newly-installed plant beds shall not be allowed. All growth shall be completely removed, including the root system. All weeds shall be completely removed from plant beds and earth saucers weekly and at the end of the establishment period.

3.9.2.3 Pesticide Treatment

Treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.9.2.4 Post-Fertilization

The plant material shall be topdressed at least once during the period of establishment with controlled release fertilizer, reference paragraph SOIL AMENDMENTS. Apply at the rate of 1 kilogram per 10 square meters of plant pit or bed area. Dry fertilizer adhering to plants shall be flushed off. The application shall be timed prior to the advent of winter dormancy.

3.9.2.5 Plant Pit Settling

When settling occurs to the backfill soil mixture, additional backfill soil shall be added to the plant pit or plant bed until the backfill level is equal to the surrounding grade. Serious settling that affects the setting of the plant in relation to the maximum depth at which it was grown requires replanting in accordance with paragraph INSTALLATION. The earth berm shall be maintained.

3.9.2.6 Maintenance Record

A record shall be furnished describing the maintenance work performed, the quantity of plant losses, diagnosis of the plant loss, and the quantity of replacements made on each site visit.

3.9.3 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. Trees unable to remain upright (without staking) shall be removed immediately and replaced as soon as seasonal conditions permit. A shrub or groundcover shall be considered unhealthy or dead when over 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall replace the plant in-kind as soon as seasonal conditions permit and with the same size as the plant being replaced or provide alternative recommendations for replacement (substitutions to be approved by COR). Unhealthy or dead plant material shall be removed immediately.

3.9.4 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION, and recommendations in paragraph PLANT ESTABLISHMENT PERIOD. Plant material shall be replaced in accordance with paragraph WARRANTY. The guarantee of all replacement plants shall extend for an additional period of one year from the date of their acceptance after replacement. The Contractor shall make periodic inspections, at no extra cost, during the guarantee period to determine what changes, if any, should be made in the maintenance program. If changes are recommended, they shall be submitted in writing to the Contracting Officer. Claims by the Contractor that the owner's maintenance practices or lack of maintenance resulted in dead or dying plants will not be considered if such claims have not been documented by the Contractor during the guarantee period.

3.10 FINAL ACCEPTANCE

3.10.1 Preliminary Inspection

Prior to the end of the plant installation a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The quantity and type of plants installed and the acceptability of the plants, in accordance with paragraph 3.9 Maintenance Required Prior to Commencement of the Plant Establishment Period, shall be determined. Plants shall be in a healthy, vigorous condition. For 41st Division Drive, the inspection shall be coordinated with Fort Lewis Communities LLC, Managing Director, Mr. Mike Bissell, 253 966 8264, in addition to the Contracting Officer.

3.10.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. Acceptance of the planting operation is subject to the guarantee of plant growth. For 41st Division Drive, the inspection shall be coordinated with Fort Lewis Communities LLC, Managing Director, Mr. Mike Bissell, 253 966 8264, in addition to the Contracting Officer.

END OF SECTION

SECTION 02935

EXTERIOR PLANT MATERIAL MAINTENANCE

PART 1 GENERAL

This specification applies to the one-year plant establishment (maintenance) period for all plant material, irrigation operation, and all landscape materials installed under Specification Sections 02811, 02921, 02922, and 02930. The one-year plant establishment period shall begin following final acceptance by the Contracting Officer of the installed seeding, sodding, exterior plant materials, and irrigation system(s).

Written calendar time period shall be furnished for the commencement of the plant establishment period. Use of more than one plant establishment period may be used with approval from the Contracting Officer: the boundaries of the planted area/zone covered for each period shall be described. The plant establishment period shall be coordinated with Sections 02921 SEEDING and 02922 SODDING; 02811 UNDERGROUND SPRINKLER SYSTEM; and 02935 EXTERIOR PLANT MATERIAL MAINTENANCE. The plant establishment period shall be modified for inclement weather shut down periods, or for separate completion dates for areas.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A300	(1995) Tree Care Operations - Trees, Shrubs and other Woody Plant Maintenance
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 602	(1995a) Agricultural Liming Materials
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ASTM D 4972	(1995a) pH of Soils
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Chemical Treatment Material;

Manufacturer's literature including physical characteristics, application and installation instructions for chemical treatment material.

Application of Pesticide; G

Pesticide treatment plan with sequence of treatment work with dates and times. The pesticide trade name, EPA registration number, chemical composition, formulation, concentration of original and diluted material, application rate of active ingredients, method of application, area treated, amount applied; and the name and state license number of the state certified applicator shall be included.

SD-06 Test Reports

Soil Tests; G
Percolation Test;

Certified reports of inspections and laboratory tests, prepared by an independent testing agency, including analysis and interpretation of test results. Each report shall be properly identified. Test methods used and compliance with recognized test standards shall be described.

SD-07 Certificates

Plant Material; G
Topsoil; G
pH Adjuster;
Fertilizer;
Organic Material;
Mulch; G
Pesticide; G

Prior to the delivery of materials, certificates of compliance attesting that materials meet the specified requirements. Certified copies of the material certificates shall include the following:

- a. Plant Material: Classification, botanical name, common name, size, quantity by species, and location where grown.
- b. Topsoil: Particle size, pH, organic matter content, textural class, soluble salts, chemical and mechanical analyses.
- c. pH Adjuster. Calcium carbonate equivalent and sieve analysis.
- d. Fertilizer. Chemical analysis and composition percent.
- e. Organic Material: Composition and source.
- f. Mulch: Composition and source.
- g. Pesticide. EPA registration number and registered uses.

SD-10 Operation and Maintenance Data

Plant Establishment Period; G

Calendar time period for the plant establishment period. When there is more than one establishment period, the boundaries of the planted areas covered for each period shall be described.

Work Plan and Schedule ; G
Delivery Schedule; G

Contractor's work plan including Maintenance Instructions, Task Charts (see 3.6 General Maintenance Requirements) and schedules.

Maintenance Record; G

Contractor's record of each site visit.

1.3 DELIVERY, INSPECTION, STORAGE, AND HANDLING

1.3.1 Delivery Schedule

A delivery schedule shall be provided at least 10 calendar days prior to the first day of delivery.

1.3.2 Delivery of Pesticides

Pesticide material shall be delivered to the site in the original, unopened containers bearing legible labels indicating the EPA registration number and the manufacturer's registered uses.

1.3.3 Storage

Materials shall be stored in designated areas. Lime and fertilizer shall be stored in cool, dry locations away from contaminants. Chemical treatment material shall be stored according to manufacturer's instructions and not with seeding operation materials.

1.3.4 Handling

Except for bulk deliveries, materials shall not be dropped or dumped from vehicles.

PART 2 PRODUCTS

2.1 SOIL AMENDMENTS

Soil amendments shall consist of pH adjuster, fertilizer, organic material and soil conditioners meeting the following requirements. Vermiculite shall not be used.

2.1.1 pH Adjuster

The pH adjuster shall be an agricultural liming material in accordance with ASTM C 602. These materials may be burnt lime, hydrated lime, ground limestone, sulfur, or shells. The pH adjuster shall be used to create a favorable soil pH for the plant material specified or in place.

2.1.1.1 Limestone

Limestone material shall contain a minimum calcium carbonate equivalent of 80 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 55 percent shall pass through a 0.250 mm (No. 60) sieve. To raise soil pH, ground limestone shall be used.

2.1.1.2 Hydrated Lime

Hydrated lime shall contain a minimum calcium carbonate equivalent of 110 percent. Gradation: A minimum 100 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 97 percent shall pass through a 0.250 mm (No. 60) sieve.

2.1.1.3 Burnt Lime

Burnt lime shall contain a minimum calcium carbonate equivalent of 140 percent. Gradation: A minimum 95 percent shall pass through a 2.36 mm (No. 8) sieve and a minimum 35 percent shall pass through a 0.250 mm (No. 60) sieve.

2.1.2 Fertilizer

Fertilizer shall be controlled release commercial grade, free flowing, uniform in composition, and consist of a nitrogen-phosphorus-potassium ratio. The nutrients ratio shall be 20 percent nitrogen, 10 percent phosphorus, and 10 percent potassium. The fertilizer shall be derived from sulfur coated urea, urea formaldehyde, plastic or polymer coated pills, or isobutylenediurea (IBDU). Fertilizer shall be balanced with the inclusion of trace minerals and micro-nutrients.

2.1.3 Nitrogen Carrier Fertilizer

Nitrogen carrier fertilizer shall be commercial grade, free flowing, and uniform in composition. The nutrients ratio shall be 20 percent nitrogen, 10 percent phosphorus, and 10 percent potassium. The fertilizer may be a liquid nitrogen solution.

2.1.4 Organic Material

Organic material shall consist of bonemeal, rotted manure, decomposed wood derivatives, recycled compost, or worm castings.

2.1.4.1 Bonemeal

Bonemeal shall be finely ground, steamed bone product containing from 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.1.4.2 Rotted Manure

Rotted manure shall be unleached horse, chicken or cattle manure containing a maximum 25 percent by volume of straw, sawdust, or other bedding materials. It shall contain no chemicals or ingredients harmful to plants. The manure shall be heat treated to kill weed seeds.

2.1.4.3 Recycled Compost

Recycled compost shall be well decomposed, stable, weed free organic matter source. Compost shall be derived from food; agricultural or industrial residuals; biosolids (treated sewage sludge); yard trimmings; or source-separated or mixed solid waste. The compost shall possess no objectionable odors and shall not resemble the raw material from which it was derived. The material shall not contain substances toxic to plants. Gradation: The compost material shall pass through a 10 mm screen, possess a pH of 5.5 to 8.0, and have a moisture content between 35-55 percent by weight. The material shall not contain more than 1 percent by weight of man-made foreign matter. Compost shall be cleaned of plastic materials larger than 50 mm in length.

2.1.4.4 Worm Castings

Worm castings shall be screened from worms and food source, commercially packaged.

2.1.5 Soil Conditioner

Soil conditioner shall be sand, super absorbent polymers, calcined clay, or gypsum for use singly or in combination.

2.1.5.1 Sand

Sand shall be clean and free of toxic materials. Gradation: A minimum 95 percent by weight shall pass a 2 mm sieve and a minimum 10 percent by weight shall pass a 1.18 mm sieve. Green sand shall be balanced with the inclusion of trace minerals and nutrients.

2.1.5.2 Calcined Clay

Calcined clay shall be granular particles produced from montmorillonite clay calcined to a minimum temperature of 650 degrees C. Gradation: A minimum 90 percent shall pass a 2.36 mm sieve; a minimum 99 percent shall be retained on a 0.250 mm sieve; and a maximum 2 percent shall pass a 0.150 mm sieve. Bulk density: A maximum 640 kilogram per cubic meter.

2.1.5.3 Gypsum

Gypsum shall be commercially packaged, free flowing, and a minimum 95 percent calcium sulfate by volume.

2.2 MULCH

Mulch shall be free from weeds, mold, and other deleterious materials. Mulch materials shall be native to the region. Rotted manure shall not be used.

2.2.1 Inorganic Mulch

Where inorganic mulch is used for decorative purposes, it shall be replaced or augmented in areas designated. Match existing mulch in size, color, and texture.

2.2.2 Organic Mulch

Organic mulch materials shall be ground fir or hemlock bark, medium size, for use when mulching trees, shrubs, and ground covers.

2.3 WATER

Water for will be furnished by the Government by the newly installed Whole Barracks Renewal FY03 Project irrigation system(s) and by watering trucks (Seed Mix 'C' areas at Echo Block and all plants for 41st Division Drive). Watering trucks shall be supplied by the Contractor at their expense. Water will be Government furnished. The point of contact for the locations to fill the watering trucks is Mr. Loren Brown at Ft. Lewis Public Works, (253) 967-4876. Water shall not contain elements toxic to plant life.

2.4 PESTICIDE

Pesticide shall be an insecticide, herbicide, fungicide, nematocide, rodenticide or miticide. For the purpose of this specification, a soil fumigant shall have the same requirements as a pesticide. The pesticide material shall be EPA registered and approved.

2.5 HERBICIDE

Herbicide shall be EPA registered and approved; furnished for preemergence application for crabgrass control and broad leaf weed control and complying with Federal Insecticide, Fungicide, and Rodenticide Act (Title 7 U.S.C. Section 136) for requirements on Contractor's licensing, certification, and record keeping. Contractor shall keep records of all pesticide applications and forward data monthly to Contracting Officer. Record keeping format shall be submitted to Contracting Officer for approval.

PART 3 EXECUTION

3.1 SOIL TESTS

Contractor shall perform soil tests in accordance with ASTM D 4972 and shall be required when lawn or plant establishment is below acceptable standards or as directed by the Contracting Officer.

3.2 SITE PREPARATION

3.2.1 Applying pH Adjuster

The pH adjuster shall be applied at a rate as recommended based on soil test or by manufacturer.

3.2.2 Applying Fertilizer

Apply fertilizer at rate as recommended based on soil test or by manufacturer.

3.3 MULCHING

Mulch shall be applied to a minimum depth of 50mm when less than 25mm of mulch exists.

3.4 WATERING

Water to supplement rainfall shall be applied at a rate sufficient to ensure plant growth (approx. 25mm per week for tree, shrub, and groundcover areas and approx. 38mm per week for turf areas or as indicated by irrigation system soil moisture sensors or weather-based controllers). Run-off and puddling shall be prevented. Watering trucks shall not be driven over turf areas, unless otherwise directed. Watering of other adjacent areas or plant material shall be prevented.

3.5 APPLICATION OF PESTICIDE

When application of a pesticide becomes necessary to remove a pest or disease, a pesticide treatment plan shall be submitted and coordinated with the Installation Pest Management Coordinator.

3.5.1 Technical Representative

The Installation Pest Management Coordinator shall be the technical representative, and shall be present at all meetings concerning treatment measures for pest or disease control.

3.5.2 Application

A Washington State licensed applicator shall apply required pesticides in accordance with EPA label restrictions and recommendations. Clothing and personal protective equipment shall be used as specified on the pesticide label. A closed system is recommended to prevent the pesticide from coming into contact with the applicator or other persons. Water for formulating shall only come from designated locations. Filling hoses shall be fitted with a backflow preventer meeting local plumbing codes or standards. Overflow shall be prevented during the filling operation. Prior to each day of use, the equipment used for applying pesticide shall be inspected for leaks, clogging, wear, or damage. Any repairs are to be performed immediately.

3.6 GENERAL MAINTENANCE REQUIREMENTS

Maintenance requirements shall predominantly follow the maintenance instructions provided in Section 02930 Exterior Planting, Maintenance Required Prior to Commencement of the Plant Establishment Period.

3.6.1 Maintenance Instructions For Landscaping

Written instructions shall be furnished containing drawings and other necessary information for year-round care of the installed plant material; including, when and where maintenance should occur, and the procedures for plant material replacement. For Echo Block only, plant photographs of representative specimens of each type of tree, shrub, and groundcover in the plant list and approved substitutions used on the project shall be included. Plant photographs shall be color and 75mm x 125mm taken from an angle that depicts the size and condition of the typical plant furnished in the project. A scale rod or other measuring device shall be included in the photograph. Label each photograph with the plant name, plant size, and name of the growing nursery.

A Task Chart or matrix indicating activities or tasks as required per this specification that should be occurring each month shall be submitted to the Contracting Officer for approval. A separate chart shall be provided for Echo Block and 41st Division Drive. An example of the type of formatting to use for a Task Chart is provided below.

EXAMPLE: TASK CALENDAR FOR FT. LEWIS LANDSCAPE MAINTENANCE

J	F	M	A	M	J	J	A	S	O	N	D	
	X	X	X	X	X	X	X	X	X			Mow as needed.
			X				X					Apply organic mulch to planting beds and trees in lawns (maintain 75mm layer) annually.
			X		X			X		X		Fertilize lawn areas with balanced fertilizer.
			X			X		X				Re-edge hand-tooled edging around individual trees in lawn areas.
				X	X	X	X	X				Water vegetation to maintain optimal growth as needed. Check irrigation system operation.
				X	X	X	X					Weed plant beds.
			X					X				Repair bare spots in seeded lawn areas as needed.
	X											Repair sod as needed.
		X	X	X					X	X	X	Replace dead and dying Ball & Burlap (B & B) deciduous trees and shrubs.
			X	X					X			Replace dead and dying B & B evergreen trees and shrubs.
												Other tasks as required per spec.
												“ “ “ “ “ “

3.6.1 Fertilization

Fertilizer shall be applied at rate as recommended by the manufacturer. Application shall be timed prior to the advent of winter dormancy and performed without burning plants.

3.6.2 Pesticide Treatment

Pesticide treatment for disease or pest shall be in accordance with paragraph APPLICATION OF PESTICIDE.

3.6.3 Irrigation Maintenance

The Contractor shall service and repair controller, pumps, valves, couplers, sprinklers, sprinkler heads, piping; and shall be responsible for winterization and startup. Sprinkler heads shall direct water away from building. The plant material shall be watered as necessary to prevent desiccation and to maintain an adequate supply of moisture within the root zone; the amount of water required shall be the equivalent of 25 mm absorbed water per week for trees, shrubs, and groundcover areas and the equivalent of 38mm absorbed water per week for turf areas. Amount of irrigation watering shall take amounts of rain into account. See also Section 02811 Underground Sprinkler System.

The contractor shall develop a Task Chart or matrix depicting operation and maintenance activities recommended for the installed irrigation system(s) for each month of the year. An example of the type of formatting to use for a Task Chart is provided below:

EXAMPLE: TASK CALENDAR FOR FT. LEWIS GROUNDS IRRIGATION MAINTENANCE

J	F	M	A	M	J	J	A	S	O	N	D	
			X	X	X	X	X	X	X			Observe sprinkler heads for water output. Ensure sprinkler heads are adjusted correctly, including arc, spray height, and coverage.
			X	X	X	X	X					Observe pressure gauge downstream of the zone valve during full flow conditions. Adjust as necessary to meet requirements for sprinklers.
			X	X	X	X	X					Observe pressure gauge downstream of pressure regulator to determine if pressure is within limits of system design levels. If not, adjust or replace pressure regulator.
			X	X	X	X	X	X	X			Observe controller operation for day, time and length of watering.
			X	X	X	X	X	X	X			Repair and replace missing, damaged, or irrigation components as necessary. Flush system after repairs are completed.
										X		Winter shut-down.
			X									Spring start-up.
			X	X	X	X	X	X	X			Operate the irrigation system(s) and water vegetation to maintain optimal growth as needed.
			X	X	X	X	X	X	X	X		Training for Ft. Lewis Public Works on irrigation system(s) operation and maintenance.
												Other tasks as required per spec.
												“ “ “ “ “ “

3.6.4 Maintenance Record

A record of each site visit shall be furnished, describing:

- a. Maintenance work performed.
- b. Areas repaired or reinstalled.
- c. Diagnosis for unsatisfactory stand of grass.
- d. Diagnosis for unsatisfactory stand of plant material in planting bed.
- e. Condition of trees.
- f. Condition of shrubs.
- g. Quantity and diagnosis of plant loss.

- h. Irrigation system observation and checking performed.

3.7 GRASS PLANT QUALITY

Grass plants shall be evaluated for species and health when the grass plants are a minimum 25 mm high. The living grass area shall be maintained to be uniform in color and leaf texture; and free from weeds and other undesirable growth. The living grass area shall be relatively free of thatch, diseases, nematodes, soil-borne insects, weeds or undesirable plants, stones larger than 13 mm in diameter, woody plant roots, and other materials detrimental to a healthy stand of grass plants. Broadleaf weeds and patches of foreign grasses shall be a maximum 2 percent of the total area.

3.7.1 Satisfactory Stand of Sod Grass Plants

Grass plants shall be evaluated for species and health. A satisfactory stand of grass plants from the sodding operation shall be living sod uniform in color and leaf texture. Sodded areas shall show vigorous growth and bare spots shall be a maximum 50 mm square. Joints between sod pieces shall be tight and free from weeds and other undesirable growth.

3.7.2 Satisfactory Stand of Turf Areas Seed Mix 'A'

A satisfactory stand of grass plants for a turf areas 'A' shall be as follows: Seeded areas shall show vigorous growth and bare spots shall be a maximum 150mm square. The total bare spots shall be a maximum 2 percent of the total area.

3.7.3 Satisfactory Stand of Turf Areas Seed Mix 'C'

A satisfactory stand of grass plants for a turf area 'C' shall be as follows: Seeded areas shall show vigorous growth and total bare spots shall not exceed 5 percent of the total seeded area. Bare spots shall be a maximum of 200mm square.

3.8 LAWN AND FIELD AREAS MAINTENANCE

No mowing is required for 41st Division Drive.

3.8.1 Mowing Echo Block

Turf areas (sod, Seed Mix 'A', and Seed Mix 'C') shall be mowed throughout the growing season to meet the requirements of paragraph GRASS PLANT QUALITY. Cutting height shall be adjusted according to type of grass.

3.8.1.1 Sod and Turf Areas Seed Mix 'A'

Turf areas that are sod and Seed Mix 'A' shall be mowed to a minimum 75mm height when the turf is a maximum 100mm high. Remove clippings when the amount cut prevents sunlight from reaching the ground surface.

3.8.1.2 Turf Areas Seed Mix 'C'

Turf areas that are Seed Mix 'C' shall be mowed to a minimum 88 mm height when the turf reaches a maximum height of 125mm. Clippings shall be removed when the amount cut prevents sunlight from reaching the ground surface.

3.8.2 Turf Trimming

Turf adjoining paved areas, planting beds and trees shall be kept neatly trimmed at all times, essentially after each mowing. String trimmers at trees and shrubs will not be allowed.

3.8.3 Aeration

Echo Block sod areas and Turf areas Seed Mix 'A' shall be aerated once per year using approved devices. Coring shall be performed by pulling soil plugs to minimum of 100 mm. Debris generated during aeration operations shall be removed.

3.8.4 Lime

Lime for pH modification shall be applied as required to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.5 Herbicide Weed Control

Two or more applications of a pre-emergent herbicide and of a post-emergent herbicide shall be performed to meet the requirements of paragraph GRASS PLANT QUALITY.

3.8.6 Turf Fertilization Program

A regular program of fertilization for Echo Block Seed Mix 'A' and sod shall be established to include a spring feeding and early summer feeding to meet the requirements of paragraph GRASS PLANT QUALITY. A total of 1.8kg of Nitrogen per 10 square meters shall be applied annually. Additional 0.5kg of Nitrogen per 10 square meters shall be provided as grass color warrants.

3.9 PLANTING BEDS MAINTENANCE

3.9.1 Trimming (Echo Block only)

Spent flower heads shall be removed. Seasonal succession of bloom requires removal for new plant or trimming back bulb foliage.

3.9.2 Irrigation of Planting Beds

Run-off, puddling and wilting, watering of other adjacent areas or existing plant material shall be prevented.

3.9.3 Weed Control

Grass and weeds in planting beds shall be completely removed before reaching 75 mm in height.

3.10 PLANT MATERIAL QUALITY

3.10.1 General Requirements

Plant material shall be identified as native to the region of the site or as a specimen. Plant material shall be maintained as well shaped, well grown, vigorous plant material having healthy root systems. The plant material shall be maintained as free from disease, harmful insects and insect eggs, sun-scald injury, disfigurement and abrasion. Plant material shall be free of shock or damage to branches, trunk, or root systems. Plant quality is determined by the growing conditions; climate and microclimate of the site for maintaining a healthy root system; and growth of the trunk and crown as follows.

3.10.2 Growth of Trunk and Crown

3.10.2.1 Deciduous Trees

Deciduous tree height to caliper relationship shall be maintained. Height of branching shall bear a relationship to the size and species of the tree and with the crown in good balance with the trunk. The trees shall not be "poled" or the leader removed.

- a. Single stem: The trunk shall be reasonably straight and symmetrical with crown and have a persistent main leader.
- b. Multi-stem: To be considered a stem, there shall be no division of the trunk which branches more than 150 mm from ground level.
- c. Specimen: The tree shall be well branched and pruned naturally according to the species. The form of growth desired, which may not be in accordance with natural growth habit, shall be indicated.

3.10.2.3 Deciduous Shrubs

Deciduous shrub height to number of primary stems shall be maintained. Shrubs shall be maintained as well shaped, with sufficient well-spaced side branches, and recognized by the trade as typical for the species grown in the region of the site.

3.10.2.4 Coniferous Evergreen Plant Material

Coniferous evergreen plant material height-to-spread ratio shall be maintained. The coniferous evergreen trees shall not be "poled" or the leader removed. The plant material shall be maintained to be well shaped and trimmed to form a symmetrical and tightly knit plant. The form of growth desired shall be indicated.

3.10.2.5 Broadleaf Evergreen Plant Material

Broadleaf evergreen plant material height-to-spread ratio shall be maintained. The plant material shall be shaped to be recognized by the trade as typical for the variety grown in the region of the site.

3.10.2.6 Ground Cover and Vine Plant Material

Ground cover and vine plant material shall be maintained to have a heavy, well developed, and balanced crown with vigorous, well developed root system.

3.11 SHRUB MAINTENANCE

3.11.1 Trimming and Pruning

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height, and shape).
- c. Health (removing broken, diseased branches).
- d. Rejuvenation (removing one third to one half of the older stems or branches).
- e. Visibility (signs, building security, motorist line of sight).

Shrubs shall be pruned to the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material or the theme shape of the hedge shall be retained. Limbs and branches to be pruned shall be neatly cut just outside the branch collar parallel with the trunk or adjacent larger branch; do not leave stubs. Improper cuts, stubs, dead and broken branches shall be removed.

3.11.2 Irrigation of Shrubs and Groundcovers

Run-off, puddling and wilting shall be prevented.

3.11.3 Shrub and Groundcover Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12 TREE MAINTENANCE

3.12.1 Trimming and Pruning of Trees

Trimming shall be performed to ensure the following:

- a. Safety.
- b. Quality (size, height).
- c. Health (removing broken, diseased wood branches).
- d. Visibility (signs, building security, motorist line of sight).

Trees shall be pruned to meet the requirements of paragraph PLANT MATERIAL QUALITY. Pruning shall be accomplished by trained and experienced personnel in accordance with ANSI A300. The typical growth habit of individual plant material shall be retained. Limbs and branches to be pruned shall be neatly cut just outside the branch collar parallel with the trunk or adjacent larger branch; do not leave stubs. Improper cuts, stubs, dead and broken branches shall be removed. "Headback" cuts at right angles to the line of growth will not be permitted. Trees shall not be poled or the leader removed, nor shall the leader be pruned or "topped off".

3.12.2 Irrigation of Trees

Run-off, puddling and wilting shall be prevented.

3.12.3 Tree Fertilization Program

A regular program of fertilization shall be established to include a fall feeding to meet the requirements of paragraph PLANT MATERIAL QUALITY. Use industry standards for foliage and root fertilizing the plant material inventoried.

3.12.4 Unhealthy Plant Material

A tree shall be considered unhealthy or dead when the main leader has died back, or up to a maximum 25 percent of the crown has died. Trees unable to remain upright (without staking) shall be removed immediately and replaced as soon as seasonal conditions permit. A shrub or groundcover shall be considered unhealthy or dead when over 25 percent of the plant has died. This condition shall be determined by scraping on a branch an area 2 mm square, maximum, to determine if there is a green cambium layer below the bark. The Contractor shall determine the cause for unhealthy plant material and shall replace the plant in-kind as soon as seasonal conditions permit and with the same size as the plant being replaced or provide alternative recommendations for replacement (substitutions to be approved by COR). Unhealthy or dead plant material shall be removed immediately.

3.12.5 Replacement Plant Material

Unless otherwise directed, plant material shall be provided for replacement in accordance with paragraph PLANT MATERIAL. Replacement plant material shall be installed in accordance with paragraph INSTALLATION. Plant material shall be replaced in accordance with paragraph WARRANTY. The guarantee of all replacement plants shall extend for an additional period of one year from the date of their acceptance after replacement. The Contractor shall make periodic inspections, at no extra cost, during the guarantee period to determine what changes, if any, should be made in the maintenance program. If changes are recommended, they shall be submitted in writing to the Contracting Officer. Claims by the Contractor that the owner's maintenance practices or lack of maintenance resulted in dead or dying plants will not be considered if such claims have not been documented by the Contractor during the guarantee period.

3.12.6 Removal of Flagging, Staking/guying, and Plant labeling Materials

All materials applied to any plants for the purposes of flagging, staking and guying (installed only as approved by Contracting Officer) or labeling shall be removed by the Contractor prior to the completion of the one-year plant establishment period.

3.13 RESTORATION AND CLEAN UP

3.13.1 Restoration

Existing turf areas, pavements, and facilities that have been damaged from the maintenance operations shall be restored to original condition at Contractor's expense.

3.13.2 Clean Up

Excess and waste material shall be removed from the maintenance areas and disposed off site. Adjacent paved areas shall be cleaned as determined by the Contracting Officer.

3.14 CLEANING OF PAVED AREAS

Grass, weeds, leaves, and debris from mowing, clipping, and pruning shall be removed immediately. Excess and waste material shall be removed from paved areas and disposed off site. Debris, leaves shall be removed monthly.

3.15 FINAL ACCEPTANCE

3.15.1 Preliminary Inspection

Prior to the end of the plant establishment period a preliminary inspection shall be held by the Contracting Officer. Time for the inspection shall be established in writing. The quantity and type of replacement plants installed and the acceptability of all plants maintained in accordance with the plant establishment period shall be determined. Plants shall be in a healthy, vigorous condition. All staking and guying materials (installed only as approved by Contracting Officer), and flagging, or labeling materials shall be removed from plant material by the Contractor prior to the end of the one-year maintenance period. For 41st Division Drive, the inspection shall be coordinated with Fort Lewis Communities LLC, Managing Director, Mr. Mike Bissell, 253 966 8264, in addition to the Contracting Officer.

3.15.2 Final Inspection

A final inspection shall be held by the Contracting Officer to determine that deficiencies noted in the preliminary inspection have been corrected. Time for the inspection shall be established in writing. Acceptance of the plant establishment period is subject to the guarantee of plant growth. Final acceptance of the exterior plant establishment period shall be at the end of the one-year plant establishment period and requirements specified herein and in accordance with Section 02921 Seeding; 02922 Sodding; 02930 Exterior Planting; and 02811 Underground Sprinkler System. For 41st Division Drive, the inspection shall be coordinated with Fort Lewis Communities LLC, Managing Director, Mr. Mike Bissell, 253 966 8264, in addition to the Contracting Officer.

END OF SECTION

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SECTION 03100

STRUCTURAL CONCRETE FORMWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 347R (1994) Guide to Formwork for Concrete

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation
U.S. DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1996) Voluntary Product Standard - Construction and
Industrial Plywood

FOREST STEWARDSHIP COUNCIL (FSC)

(2002) Listing of Certified Wood Products

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Formwork

Drawings showing details of formwork, including dimensions of fiber voids, joints, supports, studding and shoring, and sequence of form and shoring removal.

SD-03 Product Data

Manufacturer's data including literature describing form materials, accessories, and form releasing agents.

Form Releasing Agents ; G

Manufacturer's recommendation on method and rate of application of form releasing agents.

SD-07 Certificates

For all wood products incorporated as "certified wood" provide evidence of compliance with Forest Stewardship Council (FSC) standards for certified wood. Evidence shall consist of suppliers invoices with certified products indicated on a line item basis.

1.3 DESIGN

Formwork shall be designed in accordance with methodology of ACI 347R for anticipated loads, lateral pressures, and stresses. Forms shall be capable of producing a surface which meets the requirements of the class of finish specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Forms shall be capable of withstanding the pressures resulting from placement and vibration of concrete.

PART 2 PRODUCTS

2.1 FORM MATERIALS

2.1.1 Forms For Class A and Class B Finish

Forms for Class A and Class B finished surfaces shall be plywood panels conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II. Other form materials or liners may be used provided the smoothness and appearance of concrete produced will be equivalent to that produced by the plywood concrete form panels. Forms for round columns shall be the prefabricated seamless type.

2.1.2 Forms For Class C Finish

Forms for Class C finished surfaces shall be shiplap lumber; plywood conforming to DOC PS 1, Grade B-B concrete form panels, Class I or II; tempered concrete form hardboard conforming to AHA A135.4; other approved concrete form material; or steel, except that steel lining on wood sheathing shall not be used. Forms for round columns may have one vertical seam.

2.1.3 Forms For Class D Finish

Forms for Class D finished surfaces, except where concrete is placed against earth, shall be wood or steel or other approved concrete form material.

2.1.4 Metal Form Deck

Retain-in-place metal forms for concrete slabs and roofs shall be as specified in Section 05300 STEEL DECKING.

2.1.5 Form Ties

Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 6 mm nor more than 25 mm deep and not more than 25 mm in diameter. Removable tie rods shall be not more than 38 mm in diameter.

2.1.6 Form Releasing Agents

Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

2.1.7 Certified Wood

A minimum of 50 percent of all lumber and panel products provided under this specification shall be certified wood meeting Forest Stewardship Council standards and certification.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Formwork

Forms shall be mortar tight, properly aligned and adequately supported to produce concrete surfaces meeting the surface requirements specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE and conforming to construction tolerance given in TABLE 1. Where concrete surfaces are to have a Class A or Class B finish, joints in form panels shall be arranged as approved. Where forms for continuous surfaces are placed in successive units, the forms shall fit over the completed surface to obtain accurate alignment of the surface and to prevent leakage of mortar. Forms shall not be reused if there is any evidence of surface wear and tear or defects which would impair the quality of the surface. Surfaces of forms to be reused shall be cleaned of mortar from previous concreting and of all other foreign material before reuse. Form ties that are to be completely withdrawn shall be coated with a nonstaining bond breaker.

3.2 CHAMFERING

Except as otherwise shown, external corners that will be exposed shall be chamfered, beveled, or rounded by moldings placed in the forms.

3.3 COATING

Forms for Class A and Class B finished surfaces shall be coated with a form releasing agent before the form or reinforcement is placed in final position. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for Class C and D finished surfaces may be wet with water in lieu of coating immediately before placing concrete, except that in cold weather with probable freezing temperatures, coating shall be

mandatory. Surplus coating on form surfaces and coating on reinforcing steel and construction joints shall be removed before placing concrete.

3.4 REMOVAL OF FORMS

Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for columns, walls, side of beams and other parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

3.5 FOUNDATIONS

Concrete for footings may be placed in excavations without forms, upon inspection and approval by the Contracting Officer. Excavation width shall be a minimum of 3" greater than indicated. Stem walls, grade beams and retaining wall sides shall be formed.

TABLE 1

TOLERANCES FOR FORMED SURFACES

1.	Variations from the plumb:	In any 3 m of length ----- 6 mm
a.	In the lines and surfaces of columns, piers, walls and in arises	Maximum for entire length -- 25 mm
b.	For exposed corner columns, control-joint grooves, and other conspicuous lines	In any 6 m of length ----- 6 mm Maximum for entire length 13 mm
2.	Variation from the level or from the grades indicated on the drawings:	In any 3 m of length ----- 6 mm In any bay or in any 6 m of length ----- 10 mm
a.	In slab soffits, ceilings beam soffits, and in arises, measured before removal of supporting shores	Maximum for entire length - 20 mm

b.	In exposed lintels, sills, parapets, horizontal grooves, and other conspicuous lines	In any bay or in any 6 m of length ----- 6 mm Maximum for entire length - 13 mm
3.	Variation of the linear building lines from established position in plan	In any 6 m ----- 13 mm Maximum ----- 25 mm
4.	Variation of distance between walls, columns, partitions	6 mm per 3 m of distance, but not more than 13 mm in any one bay, and not more than 25 mm total variation
5.	Variation in the sizes and locations of sleeves, floor openings, and wall opening	Minus ----- 6 mm Plus ----- 13 mm
6.	Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls	Minus ----- 6 mm Plus ----- 13 mm
7.	Footings:	
a.	Variation of dimensions in plan	Minus ----- 13 mm Plus ----- 50 mm when formed or plus 75 mm when placed against unformed excavation
b.	Misplacement of eccentricity	2 percent of the footing width in the direction of misplacement but not more than ----- 50 mm
c.	Reduction in thickness	Minus ----- 5 percent of specified thickness
8.	Variation in steps:	Riser ----- 3 mm
a.	In a flight of stairs	Tread ----- 6 mm
b.	In consecutive steps	Riser ----- 2 mm Tread ----- 3 mm

END OF SECTION

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SECTION 03150

EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO T 111 (1983; R 1996)) Inorganic Matter or Ash in Bituminous
Materials

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 109/A 109M (1998a) Steel, Strip, Carbon, Cold-Rolled

ASTM A 167 (1999) Stainless and Heat-Resisting Chromium-Nickel
Steel Plate, Sheet, and Strip

ASTM A 480/A 480M (1999b) General Requirements for Flat-Rolled Stainless
and Heat-Resisting Steel Plate, Sheet, and Strip

ASTM A 570/A 570M (1998) Steel, Sheet and Strip, Carbon, Hot-Rolled,
Structural Quality

ASTM B 152 (1997a) Copper Sheet, Strip, Plate, and Rolled Bar

ASTM B 152M (1997a) Copper Sheet, Strip, Plate, and Rolled Bar
(Metric)

ASTM B 370 (1998) Copper Sheet and Strip for Building Construction

ASTM C 919 (1984; R 1998) Use of Sealants in Acoustical
Applications

ASTM C 920 (1998) Elastomeric Joint Sealants

ASTM D 4 (1986; R 1998) Bitumen Content

ASTM D 6	(1995) Loss on Heating of Oil and Asphaltic Compounds
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1998el) Rubber Property - Effect of Liquids
ASTM D 1190	(1997) Concrete Joint Sealer, Hot-Applied Elastic Type
ASTM D 1191	(1984; R 1994el) Concrete Joint Sealers
ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM D 1854	(1996) Jet-Fuel-Resistant Concrete Joint Sealer, Hot-Poured Elastic Type
ASTM D 2628	(1991; R 1998) Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements
ASTM D 2835	(1989; R 1998) Lubricant for Installation of Preformed Compression Seals in Concrete Pavements
ASTM D 5249	(1995) Backer Material for Use With Cold and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints
ASTM D 5329	(1996) Standard Test Method for Sealants and Fillers, Hot-Applied, for Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 513	(1974) Corps of Engineers Specifications for Rubber Waterstops
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Waterstops ; G, RE

Shop drawings and fabrication drawings provided by the manufacturer or prepared by the Contractor.

SD-03 Product Data

Preformed Expansion Joint Filler Sealant Waterstops

Manufacturer's literature, including safety data sheets, for preformed fillers and the lubricants used in their installation; field-molded sealants and primers (when required by sealant manufacturer); preformed compression seals; and waterstops.

Manufacturer's recommended instructions for installing preformed fillers, field-molded sealants; preformed compression seals; and waterstops; and for splicing non-metallic waterstops.

SD-04 Samples

Lubricant for Preformed Compression Seals

Specimens identified to indicate the manufacturer, type of material, size and quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 3 m of 25 mm nominal width or wider seal or a piece not less than 4 m of compression seal less than 25 mm nominal width. One L of lubricant shall be provided.

Field-Molded Type

Four liters of field-molded sealant and one L of primer (when primer is recommended by the sealant manufacturer) identified to indicate manufacturer, type of material, quantity, and shipment or lot represented.

Non-metallic Materials

Specimens identified to indicate manufacturer, type of material, size, quantity of material, and shipment or lot represented. Each sample shall be a piece not less than 300 mm long cut from each 61 m of finished waterstop furnished, but not less than a total of 1 m of each type, size, and lot furnished. One splice sample of each size and type for every 50 splices made in the factory and every 10 splices made at the job site. The splice samples shall be made using straight run pieces with the splice located at the mid-length of the sample and finished as required for the installed waterstop. The total length of each splice shall be not less than 300 mm long.

SD-07 Certificates

Preformed Expansion Joint Filler ;G, RE
Sealant ;G, RE
Waterstops ;G, RE

Certificates of compliance stating that the joint filler and sealant materials and waterstops conform to the requirements specified.

1.3 DELIVERY AND STORAGE

Material delivered and placed in storage shall be stored off the ground and protected from moisture, dirt, and other contaminants. Sealants shall be delivered in the manufacturer's original unopened containers. Sealants whose shelf life has expired shall be removed from the site.

PART 2 PRODUCTS

2.1 CONTRACTION JOINT STRIPS

Contraction joint strips shall be 3 mm thick tempered hardboard conforming to AHA A135.4, Class 1. In lieu of hardboard strips, rigid polyvinylchloride (PVC) or high impact polystyrene (HIPS) insert strips specifically designed to induce controlled cracking in slabs on grade may be used. Such insert strips shall have removable top section.

2.2 PREFORMED EXPANSION JOINT FILLER

Expansion joint filler shall be preformed material conforming to ASTM D 1751 or ASTM D 1752. Unless otherwise indicated, filler material shall be 10 mm thick and of a width applicable for the joint formed. Backer material, when required, shall conform to ASTM D 5249.

2.3 SEALANT

2.3.3 Hot-Poured Type

ASTM D 1190 tested in accordance with ASTM D 1191.

2.3.4 Field-Molded Type

ASTM C 920, Type M for horizontal joints or Type NS for vertical joints, Class 25, and Use NT. Bond breaker material shall be polyethylene tape, coated paper, metal foil or similar type materials. The back-up material shall be compressible, non-shrink, nonreactive with sealant, and non-absorptive material type such as extruded butyl or polychloroprene rubber.

2.4 WATERSTOPS

Intersection and change of direction waterstops shall be shop fabricated.

2.4.1 Flexible Metal

Copper waterstops shall conform to ASTM B 152M (ASTM B 152) and ASTM B 370, O60 soft anneal temper and 0.686 mm (20 oz mass per sq. ft) (20 oz mass per sq. ft) sheet thickness. Stainless steel waterstops shall conform to ASTM A 167 and ASTM A 480/A 480M, UNS S30453 (Type 304L), and 0.9525 mm (20 gauge) (20 gauge) thick strip.

2.4.2 Rigid Metal

Flat steel waterstops shall conform to ASTM A 109/A 109M, No. 2 (half hard) temper, No. 2 edge, No. 1 (matte or dull) finish or ASTM A 570/A 570M, Grade 40.

2.4.3 Non-Metallic Materials

Non-metallic waterstops shall be manufactured from a prime virgin resin; reclaimed material is not acceptable. The compound shall contain plasticizers, stabilizers, and other additives to meet specified requirements. Rubber waterstops shall conform to COE CRD-C 513. Polyvinylchloride waterstops shall conform to COE CRD-C 572. Thermoplastic elastomeric rubber waterstops shall conform to ASTM D 471.

2.4.4 Non-Metallic Hydrophilic

Swellable strip type compound of polymer modified chloroprene rubber that swells upon contact with water shall conform to ASTM D 412 as follows: Tensile strength 2.9 MPa (420 psi) minimum; ultimate elongation 600 percent minimum. Hardness shall be 50 minimum on the type A durometer and the volumetric expansion ratio in distilled water at 20 degrees C (70 degrees F) shall be 3 to 1 minimum.

2.4.5 Preformed Elastic Adhesive

Preformed plastic adhesive waterstops shall be produced from blends of refined hydrocarbon resins and plasticizing compounds reinforced with inert mineral filler, and shall contain no solvents, asbestos, irritating fumes or obnoxious odors. The compound shall not depend on oxidizing, evaporating, or chemical action for its adhesive or cohesive strength.

2.4.5.1 Chemical Composition

The chemical composition of the sealing compound shall meet the requirements shown below:

COMPONENT	PERCENT BY WEIGHT		TEST
	MIN.	MAX.	
Bitumen (Hydrocarbon plastic)	50	70	ASTM D 4
Inert Mineral Filler	30	50	AASHTO T 111
Volatile Matter		2	ASTM D 6

2.4.5.2 Adhesion Under Hydrostatic Pressure

The sealing compound shall not leak at the joints for a period of 24 hours under a vertical 2 m head pressure. In a separate test, the sealing compound shall not leak under a horizontal pressure of 65 kPa which is reached by slowly applying increments of 13 kPa every minute.

2.4.5.3 Sag of Flow Resistance

Sagging shall not be detected when tested as follows: Fill a wooden form 25 mm wide and 150 mm long flush with sealing compound and place in an oven at 58 degrees C in a vertical position for 5 days.

2.4.5.4 Chemical Resistance

The sealing compound when immersed separately in a 5% solution of caustic potash, a 5% solution of hydrochloric acid, 5% solution of sulfuric acid and a saturated hydrogen sulfide solution for 30 days at ambient room temperature shall show no visible deterioration.

PART 3 EXECUTION

3.1 JOINTS

Joints shall be installed at locations indicated and as authorized.

3.1.1 Contraction Joints

Contraction joints may be constructed by cutting the concrete with a saw after concrete has set. Joints shall be approximately 3 mm wide and shall extend into the slab one-fourth the slab thickness, minimum, but not less than 25 mm.

3.1.1.2 Sawed Joints

Joint sawing shall be early enough to prevent uncontrolled cracking in the slab, but late enough that this can be accomplished without appreciable spalling. Concrete sawing machines shall be adequate in number and power, and with sufficient replacement blades to complete the sawing at the required rate. Joints shall be cut to true alignment and shall be cut in sequence of concrete placement. Sludge and cutting debris shall be removed.

3.1.2 Expansion Joints

Preformed expansion joint filler shall be used in expansion and isolation joints in slabs around columns and between slabs on grade and vertical surfaces where indicated. The filler shall extend the full slab depth, unless otherwise indicated. The edges of the joint shall be neatly finished with an edging tool of 3 mm radius, except where a resilient floor surface will be applied. Where the joint is to receive a sealant, the filler strips shall be installed at the proper level below the finished floor with a slightly tapered, dressed and oiled wood strip temporarily secured to the top to form a recess to the size shown on the drawings. The wood strip shall be removed after the concrete has set. Contractor may opt to use a removable expansion filler cap designed and fabricated for this purpose in lieu of the wood strip. The groove shall be thoroughly cleaned of laitance, curing compound, foreign materials, protrusions of

hardened concrete, and any dust which shall be blown out of the groove with oil-free compressed air.

3.1.3 Joint Sealant

Sawed contraction joints and expansion joints in slabs shall be filled with joint sealant, unless otherwise shown. Joint surfaces shall be clean, dry, and free of oil or other foreign material which would adversely affect the bond between sealant and concrete. Joint sealant shall be applied as recommended by the manufacturer of the sealant.

3.1.3.1 Joints With Preformed Compression Seals

Compression seals shall be installed with equipment capable of installing joint seals to the prescribed depth without cutting, nicking, twisting, or otherwise distorting or damaging the seal or concrete and with no more than 5 percent stretching of the seal. The sides of the joint and, if necessary, the sides of the compression seal shall be covered with a coating of lubricant. Butt joints shall be coated with liberal applications of lubricant.

3.1.3.2 Joints With Field-Molded Sealant

Joints shall not be sealed when the sealant material, ambient air, or concrete temperature is less than 4 degrees C. When the sealants are meant to reduce the sound transmission characteristics of interior walls, ceilings, and floors the guidance provided in ASTM C 919 shall be followed. Joints requiring a bond breaker shall be coated with curing compound or with bituminous paint. Bond breaker and back-up material shall be installed where required. Joints shall be primed and filled flush with joint sealant in accordance with the manufacturer's recommendations.

3.2 WATERSTOPS, INSTALLATION AND SPLICES

Waterstops shall be installed at the locations shown to form a continuous water-tight diaphragm. Adequate provision shall be made to support and completely protect the waterstops during the progress of the work. Any waterstop punctured or damaged shall be repaired or replaced. Exposed waterstops shall be protected during application of form release agents to avoid being coated. Suitable guards shall be provided to protect exposed projecting edges and ends of partially embedded waterstops from damage when concrete placement has been discontinued. Splices shall be made by certified trained personnel using approved equipment and procedures.

3.2.1 Copper And Stainless Steel

Splices in copper waterstops shall be lap joints made by brazing. Splices in stainless steel waterstops shall be welded using a TIG or MIG process utilizing a weld rod to match the stainless. All welds shall not be annealed to maintain physical properties. Carbon flame shall not be used in the annealing process. Damaged waterstops shall be repaired by removing damaged portions and patching. Patches shall overlap a minimum of 25 mm onto undamaged portion of the waterstop.

3.2.2 Flat Steel

Splices in flat steel waterstops shall be properly aligned, butt welded, and cleaned of excessive material.

3.2.3 Non-Metallic

Fittings shall be shop made using a machine specifically designed to mechanically weld the waterstop. A miter guide, proper fixturing (profile dependant), and portable power saw shall be used to miter cut the ends to be joined to ensure good alignment and contact between joined surfaces. The splicing of straight lengths shall be done by squaring the ends to be joined. Continuity of the characteristic features of the cross section of the waterstop (ribs, tabular center axis, protrusions, etc.) shall be maintained across the splice.

3.2.3.1 Rubber Waterstop

Splices shall be vulcanized or shall be made using cold bond adhesive as recommended by the manufacturer. Splices for TPE-R shall be as specified for PVC.

3.2.3.2 Polyvinyl Chloride Waterstop

Splices shall be made by heat sealing the adjacent waterstop edges together using a thermoplastic splicing iron utilizing a non-stick surface specifically designed for waterstop welding. The correct temperature shall be used to sufficiently melt without charring the plastic. The spliced area, when cooled, shall show no signs of separation, holes, or other imperfections when bent by hand in as sharp an angle as possible.

3.2.3.3 Quality Assurance

Edge welding will not be permitted. Center bulbs shall be compressed or closed when welding to non-center bulb type. Waterstop splicing defects which are unacceptable include, but are not limited to the following: 1) Tensile strength less than 80 percent of parent section. 2) Free lap joints. 3) Misalignment of center bulb, ribs, and end bulbs greater than 2 mm. 4) Misalignment which reduces waterstop cross section more than 15 percent. 5) Bond failure at joint deeper than 2 mm or 15 percent of material thickness. 6) Misalignment of waterstop splice resulting in misalignment of waterstop in excess of 13 mm in 3 m. 7) Visible porosity in the weld area, including pin holes. 8) Charred or burnt material. 9) Bubbles or inadequate bonding. 10) Visible signs of splice separation when cooled splice is bent by hand at a sharp angle.

3.2.4 Non-Metallic Hydrophilic Waterstop Installation

Ends to be joined shall be miter cut with sharp knife or shears. The ends shall be adhered with cyanacrylate (super glue) adhesive. When joining hydrophilic type waterstop to PVC waterstop, the hydrophilic waterstop shall be positioned as shown on the drawings. A liberal amount of a single component hydrophilic sealant shall be applied to the junction to complete the transition.

3.2.5 Preformed Plastic Adhesive Installation

The installation of preformed plastic adhesive waterstops shall be a prime, peel, place and pour procedure. Joint surfaces shall be clean and dry before priming and just prior to placing the sealing strips. The end of each strip shall be spliced to the next strip with a 25 mm overlap; the overlap shall be pressed firmly to release trapped air. During damp or cold conditions the joint surface shall be flashed with a safe, direct flame to warm and dry the surface adequately; the sealing strips shall be dipped in warm water to soften the material to achieve maximum bond to the concrete surface.

3.3 CONSTRUCTION JOINTS

Construction joints are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE except that construction joints coinciding with expansion and contraction joints shall be treated as expansion or contraction joints as applicable.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(1995) Building Code Requirements for Structural Concrete and Commentary (Metric)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 184/A 184M	(1996) Fabricated Deformed Steel Bar Mats for Concrete Reinforcement
ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM A 496	(1997) Steel Wire, Deformed, for Concrete Reinforcement
ASTM A 497	(1997) Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
ASTM A 615/A 615M	(1996a) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM A 675/A 675M	(1990a; R 1995e1) Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties
ASTM A 706/A 706M	(1998) Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement
ASTM A 767/A 767M	(1997) Zinc-Coated (Galvanized) Steel Bars in Concrete Reinforcement
ASTM A 775/A 775M	(1997e1) Epoxy-Coated Reinforcement Steel Bars

ASTM A 884/A 884M (1996ae1) Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement

ASTM C 1116 (1995) Fiber-Reinforced Concrete and Shotcrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.4 (1998) Structural Welding Code - Reinforcing Steel

CONCRETE REINFORCING STEEL INSTITUTE (CRSI)

CRSI MSP-1 (1996) Manual of Standard Practice

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Reinforcement ; GA

Detail drawings showing reinforcing steel placement, schedules, sizes, grades, and splicing and bending details. Drawings shall show support details including types, sizes and spacing. Drawings shall conform to detailing and placing drawing recommendations of CRSI MSP-1.

SD-03 Product Data

Welding ; GA

A list of qualified welders names.

SD-07 Certificates

Reinforcing Steel ; GA

Certified copies of mill reports attesting that the reinforcing steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified herein, prior to the installation of reinforcing steel.

1.3 WELDING

Welders shall be qualified in accordance with AWS D1.4. Qualification test shall be performed at the worksite and the Contractor shall notify the Contracting Officer 24 hours prior to conducting tests. Special welding procedures and welders qualified by others may be accepted as permitted by AWS D1.4.

1.4 DELIVERY AND STORAGE

Reinforcement and accessories shall be stored off the ground on platforms, skids, or other supports.

PART 2 PRODUCTS

2.1 SMOOTH DOWELS

Dowels shall conform to ASTM A 675M, Grade 80. Steel pipe conforming to ASTM A 53, Schedule 80, may be used as dowels provided the ends are closed with metal or plastic inserts or with mortar.

2.2 FABRICATED BAR MATS

Fabricated bar mats shall conform to ASTM A 184M.

2.3 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to ASTM A 615M or ASTM A 706M, grades and sizes as indicated. Cold drawn wire used for spiral reinforcement shall conform to ASTM A 82. In highly corrosive environments or when directed by the Contracting Officer, reinforcing steel shall conform to ASTM A 767M or ASTM A 775M as appropriate.

2.4 WELDED WIRE FABRIC

Welded wire fabric shall conform to ASTM A 185 or ASTM A 497. When directed by the Contracting Officer for special applications, welded wire fabric shall conform to ASTM A 884M.

2.5 WIRE TIES

Wire ties shall be 16 gauge or heavier black annealed steel wire.

2.6 SUPPORTS

Bar supports for formed surfaces shall be designed and fabricated in accordance with CRSI MSP-1 and shall be steel or precast concrete blocks. Precast concrete blocks shall have wire ties and shall be not less than 100 by 100 mm when supporting reinforcement on ground. Precast concrete block shall have compressive strength equal to that of the surrounding concrete. Where concrete formed surfaces will be exposed to weather or where surfaces are to be painted, steel supports within 13 mm of concrete surface shall be galvanized, plastic protected or of stainless steel. Concrete supports used in concrete exposed to view shall have the same color and texture as the finish surface. For slabs on grade, supports shall be precast concrete blocks, plastic coated steel fabricated with bearing plates, or specifically designed wire-fabric supports fabricated of plastic.

2.7 SYNTHETIC FIBER REINFORCEMENT

Synthetic fiber shall be polypropylene with a denier less than 100 and a nominal fiber length of 50 mm. (2 inches.)

PART 3 EXECUTION

3.1 REINFORCEMENT

Reinforcement shall be fabricated to shapes and dimensions shown and shall conform to the requirements of ACI 318M. Reinforcement shall be cold bent unless otherwise authorized. Bending may be accomplished in the field or at the mill. Bars shall not be bent after embedment in concrete without prior approval of the Contracting Officer. Safety caps shall be placed on all exposed ends of vertical concrete reinforcement bars that pose a danger to life safety. Wire tie ends shall face away from the forms. "Tack" welding to or of reinforcement is prohibited welding of reinforcing bars shall be done with low hydrogen electrodes in accordance with AWS D1.4.

3.1.1 Placement

Reinforcement shall be free from loose rust and scale, dirt, oil, or other deleterious coating that could reduce bond with the concrete. Reinforcement shall be placed in accordance with ACI 318M at locations shown within tolerances of ACI 117. Reinforcement shall not be continuous through expansion isolation joints and shall be as indicated through construction or contraction joints. Concrete coverage shall be as indicated or as required by ACI 318M. If bars are moved more than one bar diameter to avoid interference with other reinforcement, conduits or embedded items, the resulting arrangement of bars, including additional bars required to meet structural requirements, shall be approved before concrete is placed.

3.1.2 Splicing

Splices of reinforcement shall conform to ACI 318M and shall be made only as required or indicated. Splicing shall be by lapping or by mechanical or welded butt connection; except that lap splices shall not be used for bars larger than No. 36M unless otherwise indicated. Welding shall conform to AWS D1.4. Welded butt splices shall be full penetration butt welds. Lapped bars shall be placed in contact and securely tied or spaced transversely apart to permit the embedment of the entire surface of each bar in concrete. Lapped bars shall not be spaced farther apart than one-fifth the required length of lap or 150 mm. Mechanical butt splices shall be in accordance with the recommendation of the manufacturer of the mechanical splicing device. Butt splices shall develop 125 percent of the specified minimum yield tensile strength of the spliced bars or of the smaller bar in transition splices. Bars shall be flame dried before butt splicing. Adequate jigs and clamps or other devices shall be provided to support, align, and hold the longitudinal centerline of the bars to be butt spliced in a straight line.

3.2 WELDED-WIRE FABRIC PLACEMENT

Welded-wire fabric shall be placed in slabs as indicated. Fabric placed in slabs on grade shall be continuous between expansion, construction, and contraction joints. Fabric placement at joints shall be as indicated. Lap splices shall be made in such a way that the overlapped area equals the distance between the outermost crosswires plus 50 mm. Laps shall be staggered to avoid continuous laps in either direction. Fabric shall be wired or clipped together at laps at intervals not to exceed 1220 mm. Fabric shall be positioned by the use of supports.

3.3 SMOOTH DOWEL INSTALLATION

Dowels shall be installed in slabs on grade at locations indicated and at right angles to joint being doweled. Dowels shall be accurately positioned and aligned parallel to the finished concrete surface before concrete placement. Dowels shall be rigidly supported during concrete placement. One end of dowels shall be coated with a bond breaker.

3.4 SYNTHETIC FIBER REINFORCED CONCRETE

Fiber reinforcement shall be added to the concrete mix in accordance with the applicable sections of ASTM C 1116 and the recommendations of the manufacturer, and in an amount of 0.1 percent by volume.

3.4 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE STRUCTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 117/117R	(1990; Errata) Standard Tolerances for Concrete Construction and Materials
ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 213R	(1987) Guide for Structural Lightweight Aggregate Concrete
ACI 214.3R	(1988) Simplified Version of the Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 303R	(1991) Guide to Cast-In-Place Architectural Concrete Practice
ACI 305R	(1991) Hot Weather Concreting
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182	(1991; R 1996) Burlap Cloth Made From Jute or Kenaf
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 31/C 31M	(1998) Making and Curing Concrete Test Specimens in the Field
ASTM C 33	(19999a) Concrete Aggregates

ASTM C 39	(1996) Compressive Strength of Cylindrical Concrete Specimens
ASTM C 42	(1999) Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 78	(1994) Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)
ASTM C 94	(1999) Ready-Mixed Concrete
ASTM C 131	(1996) Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	(1996a) Sieve Analysis of Fine and Coarse Aggregates
ASTM C 143	(1998) Slump of Hydraulic Cement Concrete
ASTM C 150	(1998a) Portland Cement
ASTM C 171	(1997a) Sheet Materials for Curing Concrete
ASTM C 172	(1999) Sampling Freshly Mixed Concrete
ASTM C 173	(1994ael) Air Content of Freshly Mixed Concrete by the Volumetric Method
ASTM C 192/C 192M	(1998) Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 231	(1997el) Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C 260	(1998) Air-Entraining Admixtures for Concrete
ASTM C 309	(1998a) Liquid Membrane-Forming Compounds for Curing Concrete
ASTM C 330	(1999) Lightweight Aggregates for Structural Concrete
ASTM C 494	(1999) Chemical Admixtures for Concrete
ASTM C 496	(1996) Splitting Tensile Strength of Cylindrical Concrete Specimens
ASTM C 552	(1991) Cellular Glass Thermal Insulation
ASTM C 567	(1999a) Unit Weight of Structural Lightweight Concrete

ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 595	(1998) Blended Hydraulic Cements
ASTM C 595M	(1997) Blended Hydraulic Cements (Metric)
ASTM C 618	(1999) Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete
ASTM C 685	(1998a) Concrete Made by Volumetric Batching and Continuous Mixing
ASTM C 881	(1999) Epoxy-Resin-Base Bonding Systems for Concrete
ASTM C 937	(1997) Grout Fluidifier for Preplaced-Aggregate Concrete
ASTM C 940	(1998a) Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory
ASTM C 989	(1999) Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars
ASTM C 1017	(1998) Chemical Admixtures for Use in Producing Flowing Concrete
ASTM C 1059	(1999) Latex Agents for Bonding Fresh to Hardened Concrete
ASTM C 1064/C 1064M	(1999) Temperature of Freshly Mixed Portland Cement Concrete
ASTM C 1077	(1998) Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation
ASTM C 1107	(1999) Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 1116	(1995) Fiber-Reinforced Concrete and Shotcrete
ASTM C 1240	(1999) Silica Fume for Use as a Mineral Admixture in Hydraulic-Cement Concrete, Mortar and Grout
ASTM D 75	(1987; R 1997) Sampling Aggregates

ASTM D 1751	(1999) Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
ASTM D 1752	(1984; R 1996el) Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 1155	(1996) Determining Floor Flatness and Levelness Using the F-Number System
ASTM E 1155M	(1996) Determining Floor Flatness and Levelness Using the F-Number System (Metric)

CORPS OF ENGINEERS (COE)

COE CRD-C 94	(1995) Surface Retarders
COE CRD-C 104	(1980) Method of Calculation of the Fineness Modulus of Aggregate
COE CRD-C 400	(1963) Requirements for Water for Use in Mixing or Curing Concrete
COE CRD-C 521	(1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete
COE CRD-C 540	(1971; R 1981) Standard Specification for Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type
COE CRD-C 572	(1974) Corps of Engineers Specifications for Polyvinylchloride Waterstop

NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST)

NIST HB 44	(1997) NIST Handbook 44: Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring Devices
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NATIONAL READY-MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA CPMB 100	(1996) Concrete Plant Standards
NRMCA TMMB 100	(1994) Truck Mixer Agitator and Front Discharge Concrete Carrier Standards

NRMCA QC 3

(1984) Quality Control Manual: Section 3, Plant
Certifications Checklist: Certification of Ready Mixed
Concrete Production Facilities

1.3 LUMP SUM CONTRACT

Under this type of contract concrete items will be paid for by lump sum and will not be measured. The work covered by these items consists of furnishing all concrete materials, reinforcement, miscellaneous embedded materials, and equipment, and performing all labor for the forming, manufacture, transporting, placing, finishing, curing, and protection of concrete in these structures.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Mixture Proportions; G

The results of trial mixture design studies along with a statement giving the maximum nominal coarse aggregate size and the proportions of ingredients that will be used in the manufacture of each strength or class of concrete, at least 14 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an approved independent commercial testing laboratory, showing that mixture design studies have been made with materials proposed for the project and that the proportions selected will produce concrete of the qualities indicated. No substitutions shall be made in the materials used in the mixture design studies without additional tests to show that the quality of the concrete is satisfactory.

SD-06 Test Reports

Testing and Inspection for Contractor Quality Control; G

Certified copies of laboratory test reports, including mill tests and all other test data, for portland cement, blended cement, pozzolan, ground granulated blast furnace slag, silica fume, aggregate, admixtures, and curing compound proposed for use on this project. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials. No cement, pozzolan or slag shall be used until notice of acceptance has been given.

SD-07 Certificates

Qualifications; G

Written documentation for Contractor Quality Control personnel.

1.5 QUALIFICATIONS

Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) Certified Workmen in one of the following grades or shall have written evidence of having completed similar qualification programs:

Concrete Field Testing Technician, Grade I
Concrete Laboratory Testing Technician, Grade I or II
Concrete Construction Inspector, Level II

Concrete Transportation Construction Inspector or
Reinforced Concrete Special Inspector, Jointly certified by American Concrete Institute (ACI), Building Official and Code Administrators International (BOCA), International Conference of Building Officials (ICBO), and Southern Building Code Congress International (SBCCI).

The foreman or lead journeyman of the flatwork finishing crew shall have similar qualification for ACI Concrete Flatwork Technician/Finisher or equal, with written documentation.

1.6 GENERAL REQUIREMENTS

1.6.1 Tolerances

Except as otherwise specified herein, tolerances for concrete batching, mixture properties, and construction as well as definition of terms and application practices shall be in accordance with ACI 117/117R. Level and grade tolerance measurements of slabs shall be made as soon as possible after finishing; when forms or shoring are used, the measurements shall be made prior to removal.

1.6.1.1 Floors

For the purpose of this Section the following terminology correlation between ACI 117/117R and this Section shall apply:

Floor Profile Quality Classification From ACI 117/117R	This Section
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Conventional Bullfloated	Same
Conventional Straightedged	Same
Flat	Float Finish or Trowel Finish

Levelness tolerance shall not apply where design requires floors to be sloped to drains or sloped for other reasons.

1.6.1.2 Floors by the Straightedge System

The flatness of the floors shall be carefully controlled and the tolerances shall be measured by the straightedge system as specified in paragraph 4.5.7 of ACI 117/117R, using a 3 m straightedge, within 72 hours after floor slab installation and before shores and/or forms are removed. Finished surfaces shall be plane, with no deviation greater than 8 when tested with a 3m straightedge.

1.6.2 Strength Requirements and w/c Ratio

1.6.2.1 Strength Requirements

Specified compressive strength (f'_c) shall be as follows:

<u>COMPRESSIVE STRENGTH</u>	<u>STRUCTURE OR PORTION OF STRUCTURE</u>
27.5 MPa (4000 psi) at 28 days	all

Concrete slabs on-grade shall have a minimum 28-day flexural strength of 4.5 MPa. Concrete made with high-early strength cement shall have a 7-day strength equal to the specified 28-day strength for concrete made with Type I or II portland cement. Compressive strength shall be determined in accordance with ASTM C 39. Flexural strength shall be determined in accordance with ASTM C 78.

- a. Evaluation of Concrete Compressive Strength. Compressive strength specimens (152 by 305 mm cylinders) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified compressive strength f'_c and no individual test result falls below the specified strength f'_c by more than 3.5 MPa. A "test" is defined as the average of two companion cylinders, or if only one cylinder is tested, the results of the single cylinder test. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the structure is considered potentially deficient.
- b. Investigation of Low-Strength Compressive Test Results. When any strength test of standard-cured test cylinders falls below the specified strength requirement by more than 3.5 MPa or if tests of field-cured cylinders indicate deficiencies in protection and curing, steps shall be taken to assure that the load-carrying capacity of the structure is not jeopardized. When the strength of concrete in place is considered potentially deficient, cores shall be obtained and tested in accordance with ASTM C 42. At least three representative cores shall be taken from each member or area of concrete in place that is considered potentially deficient. The location of cores will be determined by the Contracting Officer to least impair the strength of the structure. Concrete in the area represented by the core testing will be considered adequate if the average strength of the cores is equal to at least 85 percent of the specified strength requirement and if no single core is less than 75 percent of the specified strength requirement. Non-destructive tests (tests other than test cylinders or cores) shall not be used as a basis for acceptance or rejection. The Contractor shall perform the coring and repair the holes. Cores will be tested by the Government.
- c. Load Tests. If the core tests are inconclusive or impractical to obtain or if structural analysis does not confirm the safety of the structure, load tests may be directed by the Contracting Officer in accordance with the requirements of ACI 318/318R. Concrete work evaluated by structural analysis or by results of a load test as being understrength shall be corrected in a manner satisfactory to the Contracting Officer.

All investigations, testing, load tests, and correction of deficiencies shall be performed by and at the expense of the Contractor and must be approved by the Contracting Officer, except that if all concrete is found to be in compliance with the drawings and specifications, the cost of investigations, testing, and load tests will be at the expense of the Government.

- d. Evaluation of Concrete Flexural Strength. Flexural strength specimens (beams) shall be fabricated by the Contractor and laboratory cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 78. The strength of the concrete will be considered satisfactory so long as the average of all sets of three consecutive test results equals or exceeds the specified flexural strength and no individual test result falls below the specified flexural strength by more than 350 kPa. A "test" is defined as the average of two companion beams. Additional analysis or testing, including taking cores and/or load tests may be required at the Contractor's expense when the strength of the concrete in the slab is considered potentially deficient.

1.6.2.2 Water-Cement Ratio

Maximum water-cement ratio (w/c), by weight, for normal weight concrete shall be as follows:

<u>WATER-CEMENT RATIO, BY WEIGHT</u>	<u>STRUCTURE OR PORTION OF STRUCTURE</u>
0.4	slabs and walls
0.45	footings
0.45	other

These w/c's may cause higher strengths than that required above for compressive or flexural strength. The maximum w/c required will be the equivalent w/c as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations of ACI 211.1 for the term P which is used to denote the weight of pozzolan.

1.6.3 Air Entrainment

All concrete which shall be permanently exposed to weather shall be air entrained to contain between 4 and 7 percent total air, except that when the nominal maximum size coarse aggregate is 19 mm or smaller it shall be between 4.5 and 7.5 percent. Concrete with specified strength over 35 MPa may have 1.0 percent less air than specified above. Specified air content shall be attained at point of placement into the forms. Air content for normal weight concrete shall be determined in accordance with ASTM C 231.

1.6.4 Slump

Slump of the concrete, as delivered to the point of placement into the forms, shall be within the following limits. Slump shall be determined in accordance with ASTM C 143.

Structural Element	Slump	
	Minimum	Maximum
Walls, columns and beams	50 mm	100 mm
Foundation walls, substructure walls, footings, slabs	25 mm	100 mm
Any structural concrete approved for placement by pumping:		
At pump	50 mm	150 mm
At discharge of line	25 mm	100 mm

When use of a plasticizing admixture conforming to ASTM C 1017 or when a Type F or G high range water reducing admixture conforming to ASTM C 494 is permitted to increase the slump of concrete, concrete shall have a slump of 50 to 100 mm before the admixture is added and a maximum slump of 200 mm at the point of delivery after the admixture is added.

1.6.5 Concrete Temperature

The temperature of the concrete as delivered shall not exceed 32 degrees C. When the ambient temperature during placing is 5 degrees C or less, or is expected to be at any time within 6 hours after placing, the temperature of the concrete as delivered shall be between 12 and 25 degrees C.

1.6.6 Size of Coarse Aggregate

The largest feasible nominal maximum size aggregate (NMSA) specified in paragraph AGGREGATES shall be used in each placement. However, nominal maximum size of aggregate shall not exceed any of the following: three-fourths of the minimum cover for reinforcing bars, three-fourths of the minimum clear spacing between reinforcing bars, one-fifth of the narrowest dimension between sides of forms, or one-third of the thickness of slabs or toppings.

1.6.7 Special Properties and Products

Concrete may contain admixtures other than air entraining agents, such as water reducers, superplasticizers, or set retarding agents to provide special properties to the concrete, if specified or approved. Any of these materials to be used on the project shall be used in the mix design studies.

1.7 MIXTURE PROPORTIONS

Concrete shall be composed of portland cement, other cementitious and pozzolanic materials as specified, aggregates, water and admixtures as specified.

1.7.1 Proportioning Studies for Normal Weight Concrete

Trial design batches, mixture proportioning studies, and testing requirements for various classes and types of concrete specified shall be the responsibility of the Contractor. Except as specified for flexural strength concrete, mixture proportions shall be based on water / cement ratio and compressive strength as determined by test specimens fabricated in

accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 39. Samples of all materials used in mixture proportioning studies shall be representative of those proposed for use in the project and shall be accompanied by the manufacturer's or producer's test reports indicating compliance with these specifications. Trial mixtures having proportions, consistencies, and air content suitable for the work shall be made based on methodology described in ACI 211.1, using at least three different water-cement ratios for each type of mixture, which will produce a range of strength encompassing those required for each class and type of concrete required on the project. The maximum water-cement ratios required in subparagraph Water-Cement Ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus pozzolan, silica fume, and ground granulated blast furnace slag (GGBF slag) by the weight equivalency method as described in ACI 211.1. In the case where silica fume or GGBF slag is used, the weight of the silica fume and GGBF slag shall be included in the equations in ACI 211.1 for the term P , which is used to denote the weight of pozzolan. If pozzolan is used in the concrete mixture, the minimum pozzolan content shall be 15 percent by weight of the total cementitious material, and the maximum shall be 35 percent. Laboratory trial mixtures shall be designed for maximum permitted slump and air content. Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for any conveying or placing method proposed which requires special properties and for concrete to be placed in unusually difficult placing locations. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio, at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 192/C 192M. They shall be tested at 7 and 28 days in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength for each set of trial mix studies. In addition, a curve shall be plotted showing the relationship between 7 day and 28 day strengths. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

1.7.2 Proportioning Studies for Flexural Strength Concrete

Trial design batches, mixture proportioning studies, and testing requirements shall conform to the requirements specified in paragraph Proportioning Studies for Normal Weight Concrete, except that proportions shall be based on flexural strength as determined by test specimens (beams) fabricated in accordance with ASTM C 192/C 192M and tested in accordance with ASTM C 78. Procedures given in ACI 211.1 shall be modified as necessary to accommodate flexural strength.

1.7.3 Average Compressive Strength Required for Mixtures

The mixture proportions selected during mixture design studies shall produce a required average compressive strength (f'_{cr}) exceeding the specified compressive strength (f'_c) by the amount indicated below. This required average compressive strength, f'_{cr} , will not be a required acceptance criteria during concrete production. However, whenever the daily average compressive strength at 28 days drops below f'_{cr} during concrete production, or daily average 7-day strength drops below a strength correlated with the 28-day f'_{cr} , the mixture shall be adjusted, as approved, to bring the daily average back up to f'_{cr} . During production,

the required f'_{cr} shall be adjusted, as appropriate, based on the standard deviation being attained on the job.

1.7.3.1 Computations from Test Records

Where a concrete production facility has test records, a standard deviation shall be established in accordance with the applicable provisions of ACI 214.3R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths (f'_c) within 7 MPa of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days. Required average compressive strength f'_{cr} used as the basis for selection of concrete proportions shall be the larger of the equations that follow using the standard deviation as determined above:

$$f'_{cr} = f'_c + 1.34S \text{ where units are in MPa}$$

$$f'_{cr} = f'_c + 2.33S - 3.45 \text{ where units are in MPa}$$

Where S = standard deviation

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

NUMBER OF TESTS	MODIFICATION FACTOR FOR STANDARD DEVIATION
15	1.16
20	1.08
25	1.03
30 or more	1.00

1.7.3.2 Computations without Previous Test Records

When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength f'_{cr} shall be determined as follows:

- a. If the specified compressive strength f'_c is less than 20 MPa,

$$f'_{cr} = f'_c + 6.9 \text{ MPa}$$

- b. If the specified compressive strength f'_c is 20 to 35 MPa,

$$f'_{cr} = f'_c + 8.3 \text{ MPa}$$

- c. If the specified compressive strength f'_c is over 35 MPa,

$$f'_{cr} = f'_c + 9.7 \text{ MPa}$$

1.7.4 Average Flexural Strength Required for Mixtures

The mixture proportions selected during mixture design studies for flexural strength mixtures and the mixture used during concrete production shall be designed and adjusted during concrete production as approved, except that the overdesign for average flexural strength shall simply be 15 percent greater than the specified flexural strength at all times.

1.8 STORAGE OF MATERIALS

Cement and other cementitious materials shall be stored in weathertight buildings, bins, or silos which will exclude moisture and contaminants and keep each material completely separated. Aggregate stockpiles shall be arranged and used in a manner to avoid excessive segregation and to prevent contamination with other materials or with other sizes of aggregates. Aggregate shall not be stored directly on ground unless a sacrificial layer is left undisturbed. Reinforcing bars and accessories shall be stored above the ground on platforms, skids or other supports. Other materials shall be stored in such a manner as to avoid contamination and deterioration. Admixtures which have been in storage at the project site for longer than 6 months or which have been subjected to freezing shall not be used unless retested and proven to meet the specified requirements. Materials shall be capable of being accurately identified after bundles or containers are opened.

1.9 GOVERNMENT ASSURANCE INSPECTION AND TESTING

Day-to day inspection and testing shall be the responsibility of the Contractor Quality Control (CQC) staff. However, representatives of the Contracting Officer can and will inspect construction as considered appropriate and will monitor operations of the Contractor's CQC staff. Government inspection or testing will not relieve the Contractor of any of his CQC responsibilities.

1.9.1 Materials

The Government will sample and test aggregates, cementitious materials, other materials, and concrete to determine compliance with the specifications as considered appropriate. The Contractor shall provide facilities and labor as may be necessary for procurement of representative test samples. Samples of aggregates will be obtained at the point of batching in accordance with ASTM D 75. Other materials will be sampled from storage at the jobsite or from other locations as considered appropriate. Samples may be placed in storage for later testing when appropriate.

1.9.2 Fresh Concrete

Fresh concrete will be sampled as delivered in accordance with ASTM C 172 and tested in accordance with these specifications, as considered necessary.

1.9.3 Hardened Concrete

Tests on hardened concrete will be performed by the Government when such tests are considered necessary.

1.9.4 Inspection

Concrete operations may be tested and inspected by the Government as the project progresses. Failure to detect defective work or material will not prevent rejection later when a defect is discovered nor will it obligate the Government for final acceptance.

PART 2 PRODUCTS

2.1 CEMENTITIOUS MATERIALS

Cementitious Materials shall be portland cement, or portland cement in combination with pozzolan and shall conform to appropriate specifications listed below. Use of cementitious materials in concrete which will have surfaces exposed in the completed structure shall be restricted so there is no change in color, source, or type of cementitious material.

2.1.1 Portland Cement

ASTM C 150, Type I low alkali with a maximum 15 percent amount of tricalcium aluminate, or Type II low alkali. White portland cement shall meet the above requirements except that it may be Type I, Type II or Type III low alkali. White Type III shall be used only in specific areas of the structure, when approved in writing.

2.1.2 High-Early-Strength Portland Cement

ASTM C 150, Type III with tricalcium aluminate limited to 8percent, low alkali. Type III cement shall be used only in isolated instances and only when approved in writing.

2.1.3 Pozzolan (Fly Ash)

ASTM C 618, Class Cor F with the optional requirements for multiple factor, drying shrinkage, and uniformity from Table 2A of ASTM C 618. If pozzolan is used, it shall never be less than 15 percent nor more than 35 percent by weight of the total cementitious material. Only one class of pozzolan from a single source shall be used. Weigh fly ash separately from cement.

2.2 AGGREGATES

Aggregates shall conform to the following.

2.2.1 Fine Aggregate

Fine aggregate shall conform to the quality and gradation requirements of ASTM C 33.

2.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C 33, Class 5S. Maximum aggregate size shall be 19mm for slabs and walls and 25mm for footings (see paragraph 1.6.6).

2.3 CHEMICAL ADMIXTURES

Chemical admixtures, when required or permitted, shall conform to the appropriate specification listed. Admixtures shall be furnished in liquid form and of suitable concentration for easy, accurate control of dispensing.

2.3.1 Air-Entraining Admixture

ASTM C 260 and shall consistently entrain the air content in the specified ranges under field conditions.

2.3.2 Accelerating Admixture

ASTM C 494, Type C or E, except that calcium chloride or admixtures containing calcium chloride shall not be used.

2.3.3 Water-Reducing or Retarding Admixture

ASTM C 494, Type A, B, or D, except that the 6-month and 1-year compressive and flexural strength tests are waived.

2.3.4 High-Range Water Reducer (Super Plasticizer)

ASTM C 494, Type F or G, except that the 6-month and 1-year strength requirements are waived. The admixture shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies. Superplasticizers shall be batch plant added, extend rehoplastic time, maintain setting characteristics similar to normal concrete throughout the recommended dosage range at varying concrete temperatures, reduce water 30 to 40 percent and give higher early and ultimate strengths.

2.3.5 Surface Retarder

COE CRD-C 94.

2.3.6 Expanding Admixture

Aluminum powder type expanding admixture conforming to ASTM C 937.

2.3.7 Other Chemical Admixtures

Chemical admixtures for use in producing flowing concrete shall comply with ASTM C 1017, Type I or II. These admixtures shall be used only when approved in writing, such approval being contingent upon particular mixture control as described in the Contractor's Quality Control Plan and upon performance of separate mixture design studies.

2.4 CURING MATERIALS

2.4.1 Impervious-Sheet

Impervious-sheet materials shall conform to ASTM C 171, type optional, except, that polyethylene sheet shall not be used.

2.4.2 Membrane-Forming Compound

Membrane-Forming curing compound shall conform to ASTM C 309, Type 1-D or 2, except that only a styrene acrylate or chlorinated rubber compound meeting Class B requirements shall be used for surfaces that are to be painted or are to receive bituminous roofing, or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing, or flooring specified. Nonpigmented compound shall contain a fugitive dye, and shall have the reflective requirements in ASTM C 309 waived.

2.4.3 Burlap and Cotton Mat

Burlap and cotton mat used for curing shall conform to AASHTO M 182.

2.5 WATER

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water may be used if it meets the requirements of COE CRD-C 400.

2.6 NONSHRINK GROUT

Nonshrink grout shall conform to ASTM C 1107 and shall be a commercial formulation suitable for the proposed application. Grout shall be pre-packaged, mixed, placed and cured as recommended by the manufacturer. It shall have a minimum strength of 17 MPa at 1 day, 31 MPa at 7 days and 48 MPa at 28 days.

2.7 NONSLIP SURFACING MATERIAL

Nonslip surfacing material shall consist of 55 percent, minimum, aluminum oxide or silicon-dioxide abrasive ceramically bonded together to form a homogeneous material sufficiently porous to provide a good bond with portland cement paste; or factory-graded emery aggregate consisting of not less than 45 percent aluminum oxide and 25 percent ferric oxide. The aggregate shall be well graded from particles retained on the 0.6 mm (No. 30) sieve to particles passing the 2.36 mm (No. 8 sieve).

2.8 LATEX BONDING AGENT

Latex agents for bonding fresh to hardened concrete shall conform to ASTM C 1059.

2.9 EPOXY RESIN

Epoxy resins for use in repairs shall conform to ASTM C 881, Type V, Grade 2. Class as appropriate to the existing ambient and surface temperatures.

2.10 EMBEDDED ITEMS

Embedded items shall be of the size and type indicated or as needed for the application. Dovetail slots shall be galvanized steel. Hangers for suspended ceilings shall be as specified in Section 09510 ACOUSTICAL CEILINGS. Inserts for shelf angles and bolt hangers shall be of malleable iron or cast or wrought steel. Headed studs shall conform to ASTM A108, Grade 1010 to 1020, welded deformed bars shall conform to ASTM A496.

2.11 PERIMETER INSULATION

Perimeter insulation shall be polystyrene conforming to ASTM C 578, Type II; polyurethane conforming to ASTM C 591, Type II; or cellular glass conforming to ASTM C 552, Type I or IV.

2.12 VAPOR BARRIER

Vapor barrier shall be polyethylene sheeting with a minimum thickness of 0.15 mm (6 mils) or other equivalent material having a vapor permeance rating not exceeding 30 nanograms per Pascal per second per square meter (0.5 perms) as determined in accordance with ASTM E 96.

2.13 JOINT MATERIALS

2.13.1 Joint Fillers, Sealers, and Waterstops

Expansion joint fillers shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752. Materials for waterstops shall be in accordance with Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

2.13.2 Contraction Joints in Slabs

Sawable type contraction joint inserts shall conform to COE CRD-C 540. Nonsawable joint inserts shall have sufficient stiffness to permit placement in plastic concrete without undue deviation from a straight line and shall conform to the physical requirements of COE CRD-C 540, with the exception of Section 3.4 "Resistance to Sawing". Plastic inserts shall be polyvinyl chloride conforming to the materials requirements of COE CRD-C 572.

2.15 SYNTHETIC FIBERS FOR REINFORCING

Synthetic fibers, where noted on drawings or specifications, shall conform to ASTM C 1116, Type III, Synthetic Fiber, and as follows. Fibers shall be 100 percent virgin polypropylene fibrillated fibers containing no reprocessed olefin materials. Fibers shall have a specific gravity of 0.9, a minimum tensile strength of 480 MPa 70 ksi graded per manufacturer, and specifically manufactured to an optimum gradation for use as concrete secondary reinforcement. Fibers shall be added at the batch plant. A qualified technical representative shall instruct the concrete supplier in proper batching and mixing of materials to be provided.

PART 3 EXECUTION

3.1 PREPARATION FOR PLACING

Before commencing concrete placement, the following shall be performed. Surfaces to receive concrete shall be clean and free from frost, ice, mud, and water. Forms shall be in place, cleaned, coated, and adequately supported, in accordance with Section 03100 STRUCTURAL CONCRETE FORMWORK. Reinforcing steel shall be in place, cleaned, tied, and adequately supported, in accordance with Section 03200 CONCRETE REINFORCEMENT. Transporting and conveying equipment shall be in-place, ready for use, clean, and free of hardened concrete and foreign material. Equipment for consolidating concrete shall be at the placing site and in proper working order. Equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the placing site, in proper working condition and in sufficient amount for the entire placement. When hot, windy conditions during concreting appear probable, equipment and material shall be at the placing site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

3.1.1 Foundations

3.1.1.1 Concrete on Earth Foundations

Earth (subgrade, base, or subbase courses) surfaces upon which concrete is to be placed shall be clean, damp, and free from debris, frost, ice, and standing or running water. Prior to placement of concrete, the foundation shall be well drained and shall be satisfactorily graded and uniformly compacted. Earthwork shall be as specified in Section 02315 Excavation, Filling and Backfilling for Buildings.

3.1.1.2 Preparation of Rock

Rock surfaces upon which concrete is to be placed shall be free from oil, standing or running water, ice, mud, drummy rock, coating, debris, and loose, semidetached or unsound fragments. Joints in rock shall be cleaned to a satisfactory depth, as determined by the Contracting Officer, and to firm rock on the sides. Immediately before the concrete is placed, rock surfaces shall be cleaned thoroughly by the use of air-water jets or sandblasting as specified below for Previously Placed Concrete. Rock surfaces shall be kept continuously moist for at least 24 hours immediately prior to placing concrete thereon. All horizontal and approximately horizontal surfaces shall be covered, immediately before the concrete is placed, with a layer of mortar proportioned similar to that in the concrete mixture. Concrete shall be placed before the mortar stiffens.

3.1.2 Previously Placed Concrete

Concrete surfaces to which additional concrete is to be bonded shall be prepared for receiving the next horizontal lift by cleaning the construction joint surface with either air-water cutting, sandblasting, high-pressure water jet, or other approved method. Concrete at the side of vertical construction joints shall be prepared as approved by the Contracting Officer. Air-water cutting shall not be used on formed surfaces or surfaces congested with reinforcing steel. Regardless of the method used, the resulting surfaces shall be free from all laitance and inferior concrete so that clean surfaces of well bonded coarse aggregate are exposed and make up at least 10-percent of the surface area, distributed uniformly throughout the

surface. The edges of the coarse aggregate shall not be undercut. The surface of horizontal construction joints shall be kept continuously wet for the first 12 hours during the 24-hour period prior to placing fresh concrete. The surface shall be washed completely clean as the last operation prior to placing the next lift.

3.1.2.1 Waste Disposal

The method used in disposing of waste water employed in cutting, washing, and rinsing of concrete surfaces shall be such that the waste water does not stain, discolor, or affect exposed surfaces of the structures, or damage the environment of the project area. The method of disposal shall be subject to approval.

3.1.3 Vapor Barrier

Vapor barrier shall be provided beneath the interior on-grade concrete floor slabs. The greatest widths and lengths practicable shall be used to eliminate joints wherever possible. Joints shall be lapped a minimum of 300 mm. Torn, punctured, or damaged vapor barrier material shall be removed and new vapor barrier shall be provided prior to placing concrete. For minor repairs, patches may be made using laps of at least 300 mm. Lapped joints shall be sealed and edges patched with pressure-sensitive adhesive or tape not less than 50 mm wide and compatible with the membrane. Vapor barrier shall be placed directly on underlying subgrade, base course, or capillary water barrier, unless it consists of crushed material or large granular material which could puncture the vapor barrier. In this case, the surface shall be choked with a light layer of sand, as approved, before placing the vapor barrier. A 100 mm layer of trimmable, compactible fill (not sand) according to ACI 302.1 shall be placed on top of the vapor barrier before placing concrete. Concrete placement shall be controlled so as to prevent damage to the vapor barrier, or any covering fill.

3.1.4 Perimeter Insulation

Perimeter insulation shall be installed at locations indicated. Adhesive shall be used where insulation is applied to the interior surface of foundation walls and may be used for exterior application.

3.1.5 Embedded Items

Before placement of concrete, care shall be taken to determine that all embedded items are firmly and securely fastened in place as indicated on the drawings, or required. Conduit and other embedded items shall be clean and free of oil and other foreign matter such as loose coatings or rust, paint, and scale. The embedding of wood in concrete will be permitted only when specifically authorized or directed. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with readily removable materials to prevent the entry of concrete into voids. Welding shall not be performed on embedded metals within 300 mm of the surface of the concrete. Tack welding shall not be performed on or to embedded items.

3.2 CONCRETE PRODUCTION

3.2.1 Batching, Mixing, and Transporting Concrete

Concrete shall either be batched and mixed onsite or shall be furnished from a ready-mixed concrete plant. Ready-mixed concrete shall be batched, mixed, and transported in

accordance with ASTM C 94, except as otherwise specified. Truck mixers, agitators, and nonagitating transporting units shall comply with NRMCA TMMB 100. Ready-mix plant equipment and facilities shall be certified in accordance with NRMCA QC 3. Approved batch tickets shall be furnished for each load of ready-mixed concrete. Site-mixed concrete shall conform to the following subparagraphs.

3.2.1.1 General

The batching plant shall be located on site or off site close to the project. The batching plant shall conform to the requirements of NRMCA CPMB 100 and as specified; however, rating plates attached to batch plant equipment are not required.

3.2.1.2 Batching Equipment

The batching controls shall be semiautomatic or automatic, as defined in NRMCA CPMB 100. A semiautomatic batching system shall be provided with interlocks such that the discharge device cannot be actuated until the indicated material is within the applicable tolerance. The batching system shall be equipped with accurate recorder or recorders that meet the requirements of NRMCA CPMB 100. The weight of water and admixtures shall be recorded if batched by weight. Separate bins or compartments shall be provided for each size group of aggregate and type of cementitious material, to prevent intermingling at any time. Aggregates shall be weighed either in separate weigh batchers with individual scales or, provided the smallest size is batched first, cumulatively in one weigh batcher on one scale. Aggregate shall not be weighed in the same batcher with cementitious material. If both portland cement and other cementitious material are used, they may be batched cumulatively, provided that the portland cement is batched first. Water may be measured by weight or volume. Water shall not be weighed or measured cumulatively with another ingredient. Filling and discharging valves for the water metering or batching system shall be so interlocked that the discharge valve cannot be opened before the filling valve is fully closed. Piping for water and for admixtures shall be free from leaks and shall be properly valved to prevent backflow or siphoning. Admixtures shall be furnished as a liquid of suitable concentration for easy control of dispensing. An adjustable, accurate, mechanical device for measuring and dispensing each admixture shall be provided. Each admixture dispenser shall be interlocked with the batching and discharging operation of the water so that each admixture is separately batched and individually discharged automatically in a manner to obtain uniform distribution throughout the water as it is added to the batch in the specified mixing period. Different admixtures shall not be combined prior to introduction in water and shall not be allowed to intermingle until in contact with the cement. Admixture dispensers shall have suitable devices to detect and indicate flow during dispensing or have a means for visual observation. > The plant shall be arranged so as to facilitate the inspection of all operations at all times. Suitable facilities shall be provided for obtaining representative samples of aggregates from each bin or compartment, and for sampling and calibrating the dispensing of cementitious material, water, and admixtures. Filling ports for cementitious materials bins or silos shall be clearly marked with a permanent sign stating the contents.

3.2.1.3 Scales

The weighing equipment shall conform to the applicable requirements of CPMB Concrete Plant Standard, and of NIST HB 44, except that the accuracy shall be plus or minus 0.2 percent of scale capacity. The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other

measuring devices. The tests shall be made at the specified frequency in the presence of a Government inspector. The weighing equipment shall be arranged so that the plant operator can conveniently observe all dials or indicators.

3.2.1.4 Batching Tolerances

(A) Tolerances with Weighing Equipment

MATERIAL	PERCENT OF REQUIRED WEIGHT
Cementitious materials	0 to plus 2
Aggregate	plus or minus 2
Water	plus or minus 1
Chemical admixture	0 to plus 6

(B) Tolerances with Volumetric Equipment

For volumetric batching equipment used for water and admixtures, the following tolerances shall apply to the required volume of material being batched:

MATERIAL	PERCENT OF REQUIRED MATERIAL
Water:	plus or minus 1 percent
Chemical admixtures:	0 to plus 6 percent

3.2.1.5 Moisture Control

The plant shall be capable of ready adjustment to compensate for the varying moisture content of the aggregates and to change the weights of the materials being batched.

3.2.1.6 Concrete Mixers

Mixers shall be stationary mixers or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Should any mixer at any time produce unsatisfactory results, its use shall be promptly discontinued until it is repaired.

3.2.1.7 Stationary Mixers

Concrete plant mixers shall be drum-type mixers of tilting, nontilting, horizontal-shaft, or vertical-shaft type, or shall be pug mill type and shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed. The mixing time and uniformity shall conform to all the requirements in ASTM C 94 applicable to central-mixed concrete.

3.2.1.8 Truck Mixers

Truck mixers, the mixing of concrete therein, and concrete uniformity shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit-mixed) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it is possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed. Water shall not be added at the placing site unless specifically approved by the Quality Control Inspector; and in no case shall it exceed the specified w/c. Any such water shall be injected at the base of the mixer, not at the discharge end. The drum shall be turned an additional 30 revolutions or more if necessary until the added water is uniformly mixed into the concrete. Adjust following batches at the plant so that water will not be added at the jobsite.

3.3 TRANSPORTING CONCRETE TO PROJECT SITE

Concrete shall be transported to the placing site in truck mixers, agitators or nonagitating transporting equipment conforming to NRMCA TMMB 100.

3.4 CONVEYING CONCRETE ON SITE

Concrete shall be conveyed from mixer or transporting unit to forms as rapidly as possible and within the time interval specified by methods which will prevent segregation or loss of ingredients using following equipment. Conveying equipment shall be cleaned before each placement.

3.4.1 Buckets

The interior hopper slope shall be not less than 58 degrees from the horizontal, the minimum dimension of the clear gate opening shall be at least 5 times the nominal maximum-size aggregate, and the area of the gate opening shall not be less than 0.2 square meters. The maximum dimension of the gate opening shall not be greater than twice the minimum dimension. The bucket gates shall be essentially grout tight when closed and may be manually, pneumatically, or hydraulically operated except that buckets larger than 1.5 cubic meters shall not be manually operated. The design of the bucket shall provide means for positive regulation of the amount and rate of deposit of concrete in each dumping position.

3.4.2 Transfer Hoppers

Concrete may be charged into nonagitating hoppers for transfer to other conveying devices. Transfer hoppers shall be capable of receiving concrete directly from delivery vehicles and shall have conical-shaped discharge features. The transfer hopper shall be equipped with a hydraulically operated gate and with a means of external vibration to effect complete discharge. Concrete shall not be held in nonagitating transfer hoppers more than 30 minutes.

3.4.3 Trucks

Truck mixers operating at agitating speed or truck agitators used for transporting plant-mixed concrete shall conform to the requirements of ASTM C 94. Nonagitating equipment shall be used only for transporting plant-mixed concrete over a smooth road and when the hauling time is less than 15 minutes. Bodies of nonagitating equipment shall be smooth, watertight, metal containers specifically designed to transport concrete, shaped with rounded corners to minimize segregation, and equipped with gates that will permit positive control of the discharge of the concrete.

3.4.4 Chutes

When concrete can be placed directly from a truck mixer, agitator, or nonagitating equipment, the chutes normally attached to this equipment by the manufacturer may be used. A discharge deflector shall be used when required by the Contracting Officer. Separate chutes and other similar equipment will not be permitted for conveying concrete.

3.4.5 Belt Conveyors

Belt conveyors shall be designed and operated to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients or loss of mortar and shall be provided with positive means, such as discharge baffle or hopper, for preventing segregation of the concrete at the transfer points and the point of placing. Belt conveyors shall be constructed such that the idler spacing shall not exceed 900 mm. The belt speed shall be a minimum of 90 meters per minute and a maximum of 225 meters per minute. If concrete is to be placed through installed horizontal or sloping reinforcing bars, the conveyor shall discharge concrete into a pipe or elephant trunk that is long enough to extend through the reinforcing bars.

3.4.6 Concrete Pumps

Concrete may be conveyed by positive displacement pump when approved. The pumping equipment shall be piston or squeeze pressure type; pneumatic placing equipment shall not be used. The pipeline shall be rigid steel pipe or heavy-duty flexible hose. The inside diameter of the pipe shall be at least 3 times the nominal maximum-size coarse aggregate in the concrete mixture to be pumped but not less than 100 mm. Aluminum pipe shall not be used.

3.5 PLACING CONCRETE

Mixed concrete shall be discharged within 1-1/2 hours or before the mixer drum has revolved 300 revolutions, whichever comes first after the introduction of the mixing water to the cement and aggregates. When the concrete temperature exceeds 30 degrees C, the time shall be reduced to 45 minutes. Concrete shall be placed within 15 minutes after it has been discharged from the transporting unit. Concrete shall be handled from mixer or transporting unit to forms in a continuous manner until the approved unit of operation is completed. Adequate scaffolding, ramps and walkways shall be provided so that personnel and equipment are not supported by in-place reinforcement. Placing will not be permitted when the sun, heat, wind, or limitations of facilities furnished by the Contractor prevent proper consolidation, finishing and curing. Sufficient placing capacity shall be provided so that concrete can be kept free of cold joints.

3.5.1 Depositing Concrete

Concrete shall be deposited as close as possible to its final position in the forms, and there shall be no vertical drop greater than 1.5 meters except where suitable equipment is provided to prevent segregation and where specifically authorized. Depositing of the concrete shall be so regulated that it will be effectively consolidated in horizontal layers not more than 300 mm, except that all slabs shall be placed in a single layer. Concrete to receive other construction shall be screeded to the proper level. Concrete shall be deposited continuously in one layer

or in layers so that fresh concrete is deposited on in-place concrete that is still plastic. Fresh concrete shall not be deposited on concrete that has hardened sufficiently to cause formation of seams or planes of weakness within the section. Concrete that has surface dried, partially hardened, or contains foreign material shall not be used. When temporary spreaders are used in the forms, the spreaders shall be removed as their service becomes unnecessary. Concrete shall not be placed in slabs over columns and walls until concrete in columns and walls has been in-place at least two hours or until the concrete begins to lose its plasticity. Concrete for beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as concrete for adjoining slabs.

3.5.2 Consolidation

Immediately after placing, each layer of concrete shall be consolidated by internal vibrators, except for slabs 100 mm thick or less. The vibrators shall at all times be adequate in effectiveness and number to properly consolidate the concrete; a spare vibrator shall be kept at the jobsite during all concrete placing operations. The vibrators shall have a frequency of not less than 10,000 vibrations per minute, an amplitude of at least 0.6 mm, and the head diameter shall be appropriate for the structural member and the concrete mixture being placed. Vibrators shall be inserted vertically at uniform spacing over the area of placement. The distance between insertions shall be approximately 1-1/2 times the radius of action of the vibrator so that the area being vibrated will overlap the adjacent just-vibrated area by a reasonable amount. The vibrator shall penetrate rapidly to the bottom of the layer and at least 150 mm into the preceding layer if there is such. Vibrator shall be held stationary until the concrete is consolidated and then vertically withdrawn slowly while operating. Form vibrators shall not be used unless specifically approved and unless forms are constructed to withstand their use. Vibrators shall not be used to move concrete within the forms. Slabs 100 mm and less in thickness shall be consolidated by properly designed vibrating screeds or other approved technique. Excessive vibration of lightweight concrete resulting in segregation or flotation of coarse aggregate shall be prevented. Frequency and amplitude of vibrators shall be determined in accordance with COE CRD-C 521. Grate tampers ("jitterbugs") shall not be used.

3.5.3 Cold Weather Requirements

Special protection measures, approved by the Contracting Officer, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period. The ambient temperature of the air where concrete is to be placed and the temperature of surfaces to receive concrete shall be not less than 5 degrees C. The temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. Upon written approval, an accelerating admixture conforming to ASTM C 494, Type C or E may be used, provided it contains no calcium chloride. Calcium chloride shall not be used.

3.5.4 Hot Weather Requirements

When the ambient temperature during concrete placing is expected to exceed 30 degrees C, the concrete shall be placed and finished with procedures previously submitted and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C

1064/C 1064M. Cooling of the mixing water or aggregates or placing concrete in the cooler part of the day may be required to obtain an adequate placing temperature. A retarder may be used, as approved, to facilitate placing and finishing. Steel forms and reinforcements shall be cooled as approved prior to concrete placement when steel temperatures are greater than 49 degrees C. Conveying and placing equipment shall be cooled if necessary to maintain proper concrete-placing temperature.

Maximum Allowable Concrete Placing Temperature

Relative Humidity, Percent, During Time of Concrete Placement	Maximum Allowable Concrete Temperature Degrees
Greater than 60	33 C
40-60	30 C
Less than 40	27 C

3.5.5 Prevention of Plastic Shrinkage Cracking

During hot weather with low humidity, and particularly with appreciable wind, as well as interior placements when space heaters produce low humidity, the Contractor shall be alert to the tendency for plastic shrinkage cracks to develop and shall institute measures to prevent this. Particular care shall be taken if plastic shrinkage cracking is potentially imminent and especially if it has developed during a previous placement. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 2.1.5 of ACI 305R. In addition the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, sprinkling, ponding or wet covering. Plastic shrinkage cracks that occur shall be filled by injection of epoxy resin as directed, after the concrete hardens. Plastic shrinkage cracks shall never be trowelled over or filled with slurry.

3.5.6 Placing Concrete in Congested Areas

Special care shall be used to ensure complete filling of the forms, elimination of all voids, and complete consolidation of the concrete when placing concrete in areas congested with reinforcing bars, embedded items, waterstops and other tight spacing. An appropriate concrete mixture shall be used, and the nominal maximum size of aggregate (NMSA) shall meet the specified criteria when evaluated for the congested area. Vibrators with heads of a size appropriate for the clearances available shall be used, and the consolidation operation shall be closely supervised to ensure complete and thorough consolidation at all points. Where necessary, splices of reinforcing bars shall be alternated to reduce congestion. Where two mats of closely spaced reinforcing are required, the bars in each mat shall be placed in matching alignment to reduce congestion.

3.5.7 Placing Flowable Concrete

If a plasticizing admixture conforming to ASTM C 1017 is used or if a Type F or G high range water reducing admixture is permitted to increase the slump, the concrete shall meet all requirements of paragraph GENERAL REQUIREMENTS in PART 1. Extreme care shall be used in conveying and placing the concrete to avoid segregation. Consolidation and finishing shall meet all requirements of paragraphs Placing Concrete, Finishing Formed Surfaces, and

Finishing Unformed Surfaces. No relaxation of requirements to accommodate flowable concrete will be permitted.

3.6 CONSTRUCTION JOINTS/CONTROL JOINTS

Construction joints/control joints shall be located and constructed as indicated or approved. All reinforcement shall be continued across joints; except that reinforcement or other fixed metal items shall not be continuous through expansion/isolation joints, or through construction or contraction joints in slabs on grade. Reinforcement shall be 50 mm clear from each joint. Except where otherwise indicated, construction joints between interior slabs on grade and vertical surfaces shall consist of 1.5 kg per square meter (30 pound) asphalt-saturated felt, extending for the full depth of the slab. The perimeters of the slabs shall be free of fins, rough edges, spalling, or other unsightly appearance. Reservoir for sealant for construction and contraction joints in slabs shall be formed to the dimensions shown on the drawings by removing snap-out joint-forming inserts, by sawing sawable inserts, or by sawing to widen the top portion of sawed joints. Joints to be sealed shall be cleaned and sealed as indicated on drawings and in accordance with Section 07900 JOINT SEALING.

3.6.1 Construction Joints

For concrete other than slabs on grade, construction joints shall be located as indicated or approved. Concrete shall be placed continuously so that each unit is monolithic in construction. Fresh concrete shall not be placed against adjacent hardened concrete until it is at least 24 hours old. Construction joints shall be located as indicated or approved. Where concrete work is interrupted by weather, end of work shift or other similar type of delay, location and type of construction joint shall be subject to approval of the Contracting Officer. Construction joints not indicated on the drawings shall be located and constructed to minimize the impact on the strength of the structure. In general, such joints shall be located near the middle of the spans of supported slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs, unless otherwise approved. Joints shall be perpendicular to the main reinforcement. Unless otherwise indicated and except for slabs on grade, reinforcing steel shall extend through construction joints. Construction joints in slabs on grade shall be keyed or doweled as shown. Concrete columns, walls, or piers shall be in place at least 2 hours, or until the concrete begins to lose its plasticity, before placing concrete for beams, girders, or slabs thereon. In walls having door or window openings, lifts shall terminate at the top and bottom of the opening. Other lifts shall terminate at such levels as to conform to structural requirements or architectural details. Where horizontal construction joints in walls or columns are required, a strip of 25 mm -edge lumber, beveled and oiled to facilitate removal, shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25 mm above the underside of the strip. The strip shall be removed 1 hour after the concrete has been placed, and any irregularities in the joint line shall be leveled off with a wood float, and all laitance shall be removed. Prior to placing additional concrete, horizontal construction joints shall be prepared as specified in paragraph Previously Placed Concrete.

3.6.2 Contraction Joints in Slabs on Grade

Contraction joints shall be located and detailed as shown on the drawings. Contraction Joints shall be produced by forming a weakened plane in the concrete slab by use of rigid inserts

impressed in the concrete during placing operations or sawing a continuous slot with a concrete saw. Regardless of method used to produce the weakened plane, it shall be 1/4 the depth of the slab thickness and between 3 and 5 mm wide. For saw-cut joints, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent raveling of the edges of the saw cut. Cutting shall be completed before shrinkage stresses become sufficient to produce cracking. Reservoir for joint sealant shall be formed as previously specified.

3.6.3 Expansion/Isolation Joints

Installation of expansion/isolation joints and sealing of these joints shall conform to the drawings and requirements of Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS and Section 07900 JOINT SEALING.

3.6.4 Waterstops

Waterstops shall be installed in conformance with the locations and details shown on the drawings using materials and procedures specified in Section 03150 EXPANSION JOINTS, CONTRACTION JOINTS, AND WATERSTOPS.

3.6.5 Dowels and Tie Bars

Dowels and tie bars shall be installed at the locations shown on the drawings and to the details shown, using materials and procedures specified in Section 03200 CONCRETE REINFORCEMENT and herein. Conventional smooth "paving" dowels shall be installed in slabs using approved methods to hold the dowel in place during concreting within a maximum alignment tolerance of 1 mm in 100 mm. "Structural" type deformed bar dowels, or tie bars, shall be installed to meet the specified tolerances. Care shall be taken during placing adjacent to and around dowels and tie bars to ensure there is no displacement of the dowel or tie bar and that the concrete completely embeds the dowel or tie bar and is thoroughly consolidated.

3.7 FINISHING FORMED SURFACES

Forms, form materials, and form construction are specified in Section 03100 STRUCTURAL CONCRETE FORMWORK. Finishing of formed surfaces shall be as specified herein. Unless another type of architectural or special finish is specified, surfaces shall be left with the texture imparted by the forms except that defective surfaces shall be repaired. Unless painting of surfaces is required, uniform color of the concrete shall be maintained by use of only one mixture without changes in materials or proportions for any structure or portion of structure that requires a Class A or B finish. Except for major defects, as defined hereinafter, surface defects shall be repaired as specified herein within 24 hours after forms are removed. Repairs of the so-called "plaster-type" will not be permitted in any location. Tolerances of formed surfaces shall conform to the requirements of ACI 117/117R. These tolerances apply to the finished concrete surface, not to the forms themselves; forms shall be set true to line and grade. Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter shall be repaired as specified in paragraph Damp-Pack Mortar Repair. Defects whose surface diameter is greater than their depth shall be repaired as specified in paragraph Repair of Major Defects. Repairs shall be finished flush with adjacent surfaces and with the same surface texture. The cement used for all repairs shall be a blend of job cement with white cement proportioned so that the final color after curing and aging will

be the same as the adjacent concrete. Concrete with excessive honeycomb, or other defects which affect the strength of the member, will be rejected. Repairs shall be demonstrated to be acceptable and free from cracks or loose or drummy areas at the completion of the contract and, for Class B Finishes, shall be inconspicuous. Repairs not meeting these requirements will be rejected and shall be replaced.

3.7.1 Class A and Class B Finish

Class A finish is required where indicated in SECTION: CAST-IN-PLACE ARCHITECTURAL CONCRETE. Class B finish is required unless noted otherwise on the drawings. Fins, ravelings, and loose material shall be removed, all surface defects over 12 mm in diameter or more than 12 mm, shall be repaired and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Defects more than 12 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm. The Contractor shall prepare a sample panel for approval (as specified in PART 1) before commencing repair, showing that the surface texture and color match will be attained.

3.7.2 Class C and Class D Finish

Class C and D finish is required where indicated on the drawings. Fins, ravelings, and loose material shall be removed, and, except as otherwise indicated or as specified in Section 03100 STRUCTURAL CONCRETE FORMWORK, holes left by removal of form ties shall be reamed and filled. Honeycomb and other defects more than 12 mm deep or more than 50 mm in diameter shall be repaired. Defects more than 50 mm in diameter shall be cut back to sound concrete, but in all cases at least 25 mm.

3.7.3 Special Finishes

For surfaces requiring special finish see SECTION: CAST-IN-PLACE ARCHITECTURAL CONCRETE.

3.8 REPAIRS

3.8.1 Damp-Pack Mortar Repair

Form tie holes requiring repair and other defects whose depth is at least as great as their surface diameter but not over 100 mm shall be repaired by the damp-pack mortar method. Form tie holes shall be reamed and other similar defects shall be cut out to sound concrete. The void shall then be thoroughly cleaned, thoroughly wetted, brush-coated with a thin coat of neat cement grout and filled with mortar. Mortar shall be a stiff mix of 1 part portland cement to 2 parts fine aggregate passing the 1.18 mm (No. 16) mesh sieve, and minimum amount of water. Only sufficient water shall be used to produce a mortar which, when used, will stick together on being molded into a ball by a slight pressure of the hands and will not exude water but will leave the hands damp. Mortar shall be mixed and allowed to stand for 30 to 45 minutes before use with remixing performed immediately prior to use. Mortar shall be thoroughly tamped in place in thin layers using a hammer and hardwood block. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through to the outside face. All holes shall be packed full. Damp-pack repairs shall be moist cured for at least 48 hours.

3.8.2 Repair of Major Defects

Major defects will be considered to be those more than 12 mm deep or, for Class A and B finishes, more than 12 mm in diameter and, for Class C and D finishes, more than 50 mm in diameter. Also included are any defects of any kind whose depth is over 100 mm or whose surface diameter is greater than their depth. Major defects shall be repaired as specified below.

3.8.2.1 Surface Application of Mortar Repair

Defective concrete shall be removed, and removal shall extend into completely sound concrete. Approved equipment and procedures which will not cause cracking or microcracking of the sound concrete shall be used. If reinforcement is encountered, concrete shall be removed so as to expose the reinforcement for at least 50 mm on all sides. All such defective areas greater than 7800 square mm shall be outlined by saw cuts at least 25 mm. Defective areas less than 7800 square mm shall be outlined by a 25 mm deep cut with a core drill in lieu of sawing. All saw cuts shall be straight lines in a rectangular pattern in line with the formwork panels. After concrete removal, the surface shall be thoroughly cleaned by high pressure washing to remove all loose material. Surfaces shall be kept continually saturated for the first 12 of the 24 hours immediately before placing mortar and shall be damp but not wet at the time of commencing mortar placement. The Contractor, at his option, may use either hand-placed mortar or mortar placed with a mortar gun. If hand-placed mortar is used, the edges of the cut shall be perpendicular to the surface of the concrete. The prepared area shall be brush-coated with a thin coat of neat cement grout. The repair shall then be made using a stiff mortar, preshrunk by allowing the mixed mortar to stand for 30 to 45 minutes and then remixed, thoroughly tamped into place in thin layers. If hand-placed mortar is used, the Contractor shall test each repair area for drumminess by firm tapping with a hammer and shall inspect for cracks, both in the presence of the Contracting Officer's representative, immediately before completion of the contract, and shall replace any showing drumminess or cracking. If mortar placed with a mortar gun is used, the gun shall be a small compressed air-operated gun to which the mortar is slowly hand fed and which applies the mortar to the surface as a high-pressure stream, as approved. Repairs made using shotcrete equipment will not be accepted. The mortar used shall be the same mortar as specified for damp-pack mortar repair. If gun-placed mortar is used, the edges of the cut shall be beveled toward the center at a slope of 1:1. All surface applied mortar repairs shall be continuously moist cured for at least 7 days. Moist curing shall consist of several layers of saturated burlap applied to the surface immediately after placement is complete and covered with polyethylene sheeting, all held closely in place by a sheet of plywood or similar material rigidly braced against it. Burlap shall be kept continually wet.

3.8.2.2 Repair of Deep and Large Defects

Deep and large defects will be those that are more than 150 mm deep and also have an average diameter at the surface more than 450 mm or that are otherwise so identified by the Project Office. Such defects shall be repaired as specified herein or directed, except that defects which affect the strength of the structure shall not be repaired and that portion of the structure shall be completely removed and replaced. Deep and large defects shall be repaired by procedures approved in advance including forming and placing special concrete using applied pressure during hardening. Preparation of the repair area shall be as specified for surface application of mortar. In addition, the top edge (surface) of the repair area shall be sloped at approximately 20 degrees from the horizontal, upward toward the side from which

concrete will be placed. The special concrete shall be a concrete mixture with low water content and low slump, and shall be allowed to age 30 to 60 minutes before use. Concrete containing a specified expanding admixture may be used in lieu of the above mixture; the paste portion of such concrete mixture shall be designed to have an expansion between 2.0 and 4.0 percent when tested in accordance with ASTM C 940. A full width "chimney" shall be provided at the top of the form on the placing side to ensure filling to the top of the opening. A pressure cap shall be used on the concrete in the chimney with simultaneous tightening and revibrating the form during hardening to ensure a tight fit for the repair. The form shall be removed after 24 hours and immediately the chimney shall be carefully chipped away to avoid breaking concrete out of the repair; the surface of the repair concrete shall be dressed as required.

3.8.3 Resinous and Latex Material Repair

In lieu of the portland cement bonding coats specified above, an epoxy resin or a latex bonding agent may be used.

3.9 FINISHING UNFORMED SURFACES

The finish of all unformed surfaces shall meet the requirements of paragraph Tolerances in PART 1, when tested as specified herein.

3.9.1 General

The ambient temperature of spaces adjacent to unformed surfaces being finished and of the base on which concrete will be placed shall be not less than 10 degrees C. In hot weather all requirements of paragraphs Hot Weather Requirements and Prevention of Plastic Shrinkage Cracking shall be met. Unformed surfaces that are not to be covered by additional concrete or backfill shall have a float finish, with additional finishing as specified below, and shall be true to the elevation shown on the drawings. Surfaces to receive additional concrete or backfill shall be brought to the elevation shown on the drawings, properly consolidated, and left true and regular. Unless otherwise shown on the drawings, exterior surfaces shall be sloped for drainage, as directed. Where drains are provided, interior floors shall be evenly sloped to the drains. Joints shall be carefully made with a jointing or edging tool. The finished surfaces shall be protected from stains or abrasions. Grate tampers or "jitterbugs" shall not be used for any surfaces. The dusting of surfaces with dry cement or other materials or the addition of any water during finishing shall not be permitted. If bleedwater is present prior to finishing, the excess water shall be carefully dragged off or removed by absorption with porous materials such as burlap. During finishing operations, extreme care shall be taken to prevent over finishing or working water into the surface; this can cause "crazing" (surface shrinkage cracks which appear after hardening) of the surface. Any slabs with surfaces which exhibit significant crazing shall be removed and replaced. During finishing operations, surfaces shall be checked with a 3-meter straightedge, applied in both directions at regular intervals while the concrete is still plastic, to detect high or low areas.

3.9.2 Floated Finish

Slabs to receive more than a rough slab finish shall next be given a wood float finish. Areas as indicated on the drawings shall be given only a float finish. The screeding shall be followed immediately by darbying or bull floating before bleeding water is present, to bring the surface to a true, even plane. Then, after the concrete has stiffened so that it will withstand a

man's weight without imprint of more than 6 mm and the water sheen has disappeared, it shall be floated to a true and even plane free of ridges. Floating shall be performed by use of suitable hand floats or power driven equipment. Sufficient pressure shall be used on the floats to bring a film of moisture to the surface. Hand floats shall be made of wood, magnesium, or aluminum. Lightweight concrete or concrete that exhibits stickiness shall be floated with a magnesium float. Care shall be taken to prevent over-finishing or incorporating water into the surface.

3.9.3 Trowelled Finish

Slabs within the building, unless otherwise noted on the drawings, shall be given a trowel finish immediately following floating. After floating is complete and after the surface moisture has disappeared, unformed surfaces shall be steel-trowelled to a smooth, even, dense finish, free from blemishes including trowel marks. In lieu of hand finishing, an approved power finishing machine may be used in accordance with the directions of the machine manufacturer. Additional trowelings shall be performed, either by hand or machine until the surface has been trowelled 2 times (3 times at slabs which are exposed), with waiting period between each. Care shall be taken to prevent blistering and if such occurs, troweling shall immediately be stopped and operations and surfaces corrected. A final hard steel troweling shall be done by hand, with the trowel tipped, and using hard pressure, when the surface is at a point that the trowel will produce a ringing sound. The finished surface shall be thoroughly consolidated and shall be essentially free of trowel marks and be uniform in texture and appearance. The concrete mixture used for trowelled finished areas shall be adjusted, if necessary, in order to provide sufficient fines (cementitious material and fine sand) to finish properly.

3.9.4 Non-Slip Finish

Non-slip floors shall be constructed in accordance with the following subparagraphs.

3.9.4.1 Broomed

Areas as indicated on the drawings shall be given a broomed finish. After floating, the surface shall be lightly steel trowelled, and then carefully scored by pulling a coarse fiber push-type broom across the surface. Brooming shall be transverse to traffic or at right angles to the slope of the slab. After the end of the curing period, the surface shall be vigorously broomed with a coarse fiber broom to remove all loose or semi-detached particles.

3.9.4.2 Abrasive Aggregate

Areas as indicated on the drawings shall be given an abrasive aggregate finish. The concrete surface shall be given a float finish. Abrasive aggregate shall then immediately be uniformly sprinkled over the floated surface at a total rate of not less than 1.25 kg per square meter (0.25 psf) spread in two applications at right angles to each other. The surface shall then be trowelled to a smooth, even finish that is uniform in texture and appearance and free from blemishes including trowels marks. Immediately after curing, cement paste and laitance covering the abrasive aggregate shall be removed by steel brushing, rubbing with abrasive stone, or sandblasting to expose the abrasive particles.

3.10 EXTERIOR SLAB AND RELATED ITEMS

3.10.1 Pavements

Pavements shall be constructed where shown on the drawings. After forms are set and underlying material prepared as specified, the concrete shall be placed uniformly throughout the area and thoroughly vibrated. As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. The entire surface shall be tamped with the strike off, or consolidated with a vibrating screed, and this operation continued until the required compaction and reduction of internal and surface voids are accomplished. Care shall be taken to prevent bringing excess paste to the surface. Immediately following the final consolidation of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces. After finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of long-handled cutting straightedges. Straightedges shall be 3.75 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a 3.75 m straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is true. Before the surface sheen has disappeared and well before the concrete becomes nonplastic, the surface of the pavement shall be given a nonslip sandy surface texture by use of a burlap drag. A strip of clean, wet burlap from 1.0 to 1.5 m wide and 0.7 m longer than the pavement width shall be carefully pulled across the surface. Edges and joints shall be rounded with an edger having a radius of 3 mm.. Curing shall be as specified.

3.10.2 Sidewalks

Concrete shall be 100 mm minimum thickness. Contraction joints shall be provided at 1.75 m spaces unless otherwise indicated. Contraction joints shall be cut 25 mm deep with a jointing tool after the surface has been finished. Transverse expansion joints 12 mm thick shall be provided at changes in direction and where sidewalk abuts curbs, steps, rigid pavement, or other similar structures. Sidewalks shall be given a lightly broomed finish. A transverse slope of 1 mm per 50 mm per foot shall be provided, unless otherwise indicated. Variations in cross section shall be limited to 1 mm per 250 mm.

3.10.3 Curbs and Gutters

Concrete shall be formed, placed, and finished by hand using a properly shaped "mule" or constructed using a slipform machine specially designed for this work. Contraction joints shall be cut 75 mm deep with a jointing tool after the surface has been finished. Expansion

joints (12 mm wide) shall be provided at 35 m maximum spacing unless otherwise indicated. Exposed surfaces shall be finished using a stiff bristled brush.

3.10.4 Pits and Trenches

Pits and trenches shall be constructed as indicated on the drawings. Bottoms and walls shall be placed monolithically or waterstops and keys, shall be provided as approved.

3.11 CURING AND PROTECTION

3.11.1 General

Concrete shall be cured by an approved method for the period of time given below:

Concrete with Type III cement	3 days
All other concrete	7 days

Immediately after placement, concrete shall be protected from premature drying, extremes in temperatures, rapid temperature change, mechanical injury and damage from rain and flowing water for the duration of the curing period. Air and forms in contact with concrete shall be maintained at a temperature above 10 degrees C for the first 3 days and at a temperature above 0 degrees C for the remainder of the specified curing period. Exhaust fumes from combustion heating units shall be vented to the outside of the enclosure, and heaters and ducts shall be placed and directed so as not to cause areas of overheating and drying of concrete surfaces or to create fire hazards. Materials and equipment needed for adequate curing and protection shall be available and at the site prior to placing concrete. No fire or excessive heat, including welding, shall be permitted near or in direct contact with the concrete at any time. Except as otherwise permitted by paragraph Membrane Forming Curing Compounds, moist curing shall be provided for any areas to receive floor hardener, any paint or other applied coating, or to which other concrete is to be bonded. Concrete containing silica fume shall be initially cured by fog misting during finishing, followed immediately by continuous moist curing. Except for plastic coated burlap, impervious sheeting alone shall not be used for curing.

3.11.2 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, commencing immediately after finishing. If water or curing materials used stain or discolor concrete surfaces which are to be permanently exposed, the concrete surfaces shall be cleaned as approved. When wooden forms are left in place during curing, they shall be kept wet at all times. If steel forms are used in hot weather, nonsupporting vertical forms shall be broken loose from the concrete soon after the concrete hardens and curing water continually applied in this void. If the forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. The Contractor shall have an approved work system to ensure that moist curing is continuous 24 hours per day.

3.11.3 Membrane Forming Curing Compounds

Membrane curing shall not be used on surfaces that are to receive any subsequent treatment depending on adhesion or bonding to the concrete, including surfaces to which a smooth finish is to be applied or other concrete to be bonded. However, a styrene acrylate or chlorinated rubber compound meeting ASTM C 309, Class B requirements, may be used for surfaces which are to be painted or are to receive bituminous roofing or waterproofing, or floors that are to receive adhesive applications of resilient flooring. The curing compound selected shall be compatible with any subsequent paint, roofing, waterproofing or flooring specified. Membrane curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Curing compound shall be applied to formed surfaces immediately after the forms are removed and prior to any patching or other surface treatment except the cleaning of loose sand, mortar, and debris from the surface. All surfaces shall be thoroughly moistened with water. Curing compound shall be applied to slab surfaces as soon as the bleeding water has disappeared, with the tops of joints being temporarily sealed to prevent entry of the compound and to prevent moisture loss during the curing period. The curing compound shall be applied in a two-coat continuous operation by approved motorized power-spraying equipment operating at a minimum pressure of 500 kPa (75 psi), at a uniform coverage in accordance with the manufacturers printed instructions for each coat, and the second coat shall be applied perpendicular to the first coat. Concrete surfaces which have been subjected to rainfall within 3 hours after curing compound has been applied shall be resprayed by the method and at the coverage specified. Surfaces on which clear compound is used shall be shaded from direct rays of the sun for the first 3 days. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other sources of abrasion and contamination during the curing period.

3.11.4 Impervious Sheeting

Except for plastic coated burlap, impervious sheeting alone shall not be used for curing. Impervious-sheet curing shall only be used on horizontal or nearly horizontal surfaces. Surfaces shall be thoroughly wetted and be completely covered with the sheeting. Sheeting shall be at least 450 mm wider than the concrete surface to be covered. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 300 mm and securely weighted down or shall be lapped not less than 100 mm and taped to form a continuous cover with completely closed joints. The sheet shall be weighted to prevent displacement so that it remains in contact with the concrete during the specified length of curing. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

3.11.5 Ponding or Immersion

Concrete shall be continually immersed throughout the curing period. Water shall not be more than 10 degrees C less than the temperature of the concrete.

3.11.6 Cold Weather Curing and Protection

When the daily ambient low temperature is less than 0 degrees C the temperature of the concrete shall be maintained above 5 degrees C for the first seven days after placing. During the period of protection removal, the air temperature adjacent to the concrete surfaces shall be controlled so that concrete near the surface will not be subjected to a temperature differential of more than 13 degrees C as determined by suitable temperature measuring

devices furnished by the Contractor, as required, and installed adjacent to the concrete surface and 50 mm inside the surface of the concrete. The installation of the thermometers shall be made by the Contractor as directed.

3.12 SETTING BASE PLATES AND BEARING PLATES

After being properly positioned, column base plates, bearing plates for beams and similar structural members, and machinery and equipment base plates shall be set to the proper line and elevation with damp-pack bedding mortar, except where nonshrink grout is indicated. The thickness of the mortar or grout shall be approximately $\frac{1}{24}$ the width of the plate, but not less than 20 mm. Concrete and metal surfaces in contact with grout shall be clean and free of oil and grease, and concrete surfaces in contact with grout shall be damp and free of laitance when grout is placed. Nonshrink grout shall be used for column base plates.

3.12.1 Damp-Pack Bedding Mortar

Damp-pack bedding mortar shall consist of 1 part cement and 2-1/2 parts fine aggregate having water content such that a mass of mortar tightly squeezed in the hand will retain its shape but will crumble when disturbed. The space between the top of the concrete and bottom of the bearing plate or base shall be packed with the bedding mortar by tamping or ramming with a bar or rod until it is completely filled.

3.12.2 Nonshrink Grout

Nonshrink grout shall be a ready-mixed material requiring only the addition of water. Water content shall be the minimum that will provide a flowable mixture and completely fill the space to be grouted without segregation, bleeding, or reduction of strength.

3.12.2.1 Mixing and Placing of Nonshrink Grout

Mixing and placing shall be in conformance with the material manufacturer's instructions and as specified therein. Ingredients shall be thoroughly dry-mixed before adding water. After adding water, the batch shall be mixed for 3 minutes. Batches shall be of size to allow continuous placement of freshly mixed grout. Grout not used within 30 minutes after mixing shall be discarded. The space between the top of the concrete or machinery-bearing surface and the plate shall be filled solid with the grout. Forms shall be of wood or other equally suitable material for completely retaining the grout on all sides and on top and shall be removed after the grout has set. The placed grout shall be carefully worked by rodding or other means to eliminate voids; however, overworking and breakdown of the initial set shall be avoided. Grout shall not be retempered or subjected to vibration from any source. Where clearances are unusually small, placement shall be under pressure with a grout pump. Temperature of the grout, and of surfaces receiving the grout, shall be maintained at 18 to 30 degrees C until after setting.

3.12.2.2 Treatment of Exposed Surfaces

For metal-oxidizing nonshrink grout, exposed surfaces shall be cut back 25 mm and immediately covered with a parge coat of mortar consisting of 1 part portland cement and 2-1/2 parts fine aggregate by weight, with sufficient water to make a plastic mixture. The parge coat shall have a smooth finish. For other mortars or grouts, exposed surfaces shall have a

smooth-dense finish and be left untreated. Curing shall comply with paragraph CURING AND PROTECTION.

3.13 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

The Contractor shall perform the inspection and tests described below and, based upon the results of these inspections and tests, shall take the action required and shall submit specified reports. When, in the opinion of the Contracting Officer, the concreting operation is out of control, concrete placement shall cease and the operation shall be corrected. The laboratory performing the tests shall be onsite and shall conform with ASTM C 1077. Materials may be subjected to check testing by the Government from samples obtained at the manufacturer, at transfer points, or at the project site. The Government will inspect the laboratory, equipment, and test procedures prior to start of concreting operations and as determined by the contracting officer thereafter for conformance with ASTM C 1077.

3.13.1 Grading and Corrective Action

3.13.1.1 Fine Aggregate

At least once during each shift when the concrete plant is operating, there shall be one sieve analysis and fineness modulus determination in accordance with ASTM C 136 and COE CRD-C 104 for the fine aggregate or for each fine aggregate if it is batched in more than one size or classification. The location at which samples are taken may be selected by the Contractor as the most advantageous for control. However, the Contractor is responsible for delivering fine aggregate to the mixer within specification limits. When the amount passing on any sieve is outside the specification limits, the fine aggregate shall be immediately resampled and retested. If there is another failure on any sieve, the fact shall immediately reported to the Contracting Officer, concreting shall be stopped, and immediate steps taken to correct the grading.

3.13.1.2 Coarse Aggregate

At least once during each shift in which the concrete plant is operating, there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. The location at which samples are taken may be selected by the Contractor as the most advantageous for production control. However, the Contractor shall be responsible for delivering the aggregate to the mixer within specification limits. A test record of samples of aggregate taken at the same locations shall show the results of the current test as well as the average results of the five most recent tests including the current test. The Contractor may adopt limits for control coarser than the specification limits for samples taken other than as delivered to the mixer to allow for degradation during handling. When the amount passing any sieve is outside the specification limits, the coarse aggregate shall be immediately resampled and retested. If the second sample fails on any sieve, that fact shall be reported to the Contracting Officer. Where two consecutive averages of 5 tests are outside specification limits, the operation shall be considered out of control and shall be reported to the Contracting Officer. Concreting shall be stopped and immediate steps shall be taken to correct the grading.

3.13.2 Quality of Aggregates

Thirty days prior to the start of concrete placement, the Contractor shall perform all tests for aggregate quality required by ASTM C 33. In addition, after the start of concrete placement,

the Contractor shall perform tests for aggregate quality at least every three months, and when the source of aggregate or aggregate quality changes. Samples tested after the start of concrete placement shall be taken immediately prior to entering the concrete mixer.

3.13.3 Scales, Batching and Recording

The accuracy of the scales shall be checked by test weights prior to start of concrete operations and at least once every three months. Such tests shall also be made as directed whenever there are variations in properties of the fresh concrete that could result from batching errors. Once a week the accuracy of each batching and recording device shall be checked during a weighing operation by noting and recording the required weight, recorded weight, and the actual weight batched. At the same time, the Contractor shall test and ensure that the devices for dispensing admixtures are operating properly and accurately. When either the weighing accuracy or batching accuracy does not comply with specification requirements, the plant shall not be operated until necessary adjustments or repairs have been made. Discrepancies in recording accuracies shall be corrected immediately.

3.13.4 Batch-Plant Control

The measurement of concrete materials including cementitious materials, each size of aggregate, water, and admixtures shall be continuously controlled. The aggregate weights and amount of added water shall be adjusted as necessary to compensate for free moisture in the aggregates. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, type and source of pozzolan or slag used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic meter, cubic yard, amount of water as free moisture in each size of aggregate, and the batch aggregate and water weights per cubic meter cubic yard for each class of concrete batched during each day's plant operation.

3.13.5 Concrete Mixture

- a. Air Content Testing. Air content tests shall be made when test specimens are fabricated. In addition, at least two tests for air content shall be made on randomly selected batches of each separate concrete mixture produced during each 8-hour period of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231 for normal weight concrete and ASTM C 173 for lightweight concrete. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single test result reaches either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the air content of the batch to plot on both the air content and the control chart for range, and for determining need for any remedial action. The result of each test, or average as noted in the previous sentence, shall be plotted on a separate control chart for each mixture on which an "average line" is set at the midpoint of the specified air content range from paragraph Air Entrainment. An upper warning limit and a lower warning limit line shall be set 1.0 percentage point above and below the average line, respectively. An upper action limit and a lower action limit line

shall be set 1.5 percentage points above and below the average line, respectively. The range between each two consecutive tests shall be plotted on a secondary control chart for range where an upper warning limit is set at 2.0 percentage points and an upper action limit is set at 3.0 percentage points. Samples for air content may be taken at the mixer, however, the Contractor is responsible for delivering the concrete to the placement site at the stipulated air content. If the Contractor's materials or transportation methods cause air content loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the air content at the mixer controlled as directed.

- b. Air Content Corrective Action. Whenever points on the control chart for percent air reach either warning limit, an adjustment shall immediately be made in the amount of air-entraining admixture batched. As soon as practical after each adjustment, another test shall be made to verify the result of the adjustment. Whenever a point on the secondary control chart for range reaches the warning limit, the admixture dispenser shall be recalibrated to ensure that it is operating accurately and with good reproducibility. Whenever a point on either control chart reaches an action limit line, the air content shall be considered out of control and the concreting operation shall immediately be halted until the air content is under control. Additional air content tests shall be made when concreting is restarted.
- c. Slump Testing. In addition to slump tests which shall be made when test specimens are fabricated, at least four slump tests shall be made on randomly selected batches in accordance with ASTM C 143 for each separate concrete mixture produced during each 8-hour or less period of concrete production each day. Also, additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Test results shall be plotted on control charts which shall at all times be readily available to the Government and shall be submitted weekly. Copies of the current control charts shall be kept in the field by testing crews and results plotted as tests are made. When a single slump test reaches or goes beyond either the upper or lower action limit, a second test shall immediately be made. The results of the two tests shall be averaged and this average used as the slump of the batch to plot on both the control charts for slump and the chart for range, and for determining need for any remedial action. Limits shall be set on separate control charts for slump for each type of mixture. The upper warning limit shall be set at 12.5 mm below the maximum allowable slump specified in paragraph Slump in PART 1 for each type of concrete and an upper action limit line and lower action limit line shall be set at the maximum and minimum allowable slumps, respectively, as specified in the same paragraph. The range between each consecutive slump test for each type of mixture shall be plotted on a single control chart for range on which an upper action limit is set at 50 mm. Samples for slump shall be taken at the mixer. However, the Contractor is responsible for delivering the concrete to the placement site at the stipulated slump. If the Contractor's materials or transportation methods cause slump loss between the mixer and the placement, correlation samples shall be taken at the placement site as required by the Contracting Officer, and the slump at the mixer controlled as directed.
- d. Slump Corrective Action. Whenever points on the control charts for slump reach the upper warning limit, an adjustment shall immediately be made in the batch weights of water and fine aggregate. The adjustments are to be made so that the total

water content does not exceed that amount allowed by the maximum w/c ratio specified, based on aggregates which are in a saturated surface dry condition. When a single slump reaches the upper or lower action limit, no further concrete shall be delivered to the placing site until proper adjustments have been made. Immediately after each adjustment, another test shall be made to verify the correctness of the adjustment. Whenever two consecutive individual slump tests, made during a period when there was no adjustment of batch weights, produce a point on the control chart for range at or above the upper action limit, the concreting operation shall immediately be halted, and the Contractor shall take appropriate steps to bring the slump under control. Additional slump tests shall be made as directed.

- e. Temperature. The temperature of the concrete shall be measured when compressive strength specimens are fabricated. Measurement shall be in accordance with ASTM C 1064/C 1064M. The temperature shall be reported along with the compressive strength data.
- f. Strength Specimens. At least one set of test specimens shall be made, for compressive or flexural strength as appropriate, on each different concrete mixture placed during the day for each 380 cubic meters or portion thereof of that concrete mixture placed each day. Additional sets of test specimens shall be made, as directed by the Contracting Officer, when the mixture proportions are changed or when low strengths have been detected. A truly random (not haphazard) sampling plan shall be developed by the Contractor and approved by the Contracting Officer prior to the start of construction. The plan shall assure that sampling is done in a completely random and unbiased manner. A set of test specimens for concrete with a 28-day specified strength per paragraph Strength Requirements in PART 1 shall consist of four specimens, two to be tested at 7 days and two at 28 days. Test specimens shall be molded and cured in accordance with ASTM C 31/C 31M and tested in accordance with ASTM C 39 for test cylinders and ASTM C 78 for test beams. Results of all strength tests shall be reported immediately to the Contracting Officer. Quality control charts shall be kept for individual strength "tests", ("test" as defined in paragraph Strength Requirements in PART 1) moving average of last 3 "tests" for strength, and moving average for range for the last 3 "tests" for each mixture. The charts shall be similar to those found in ACI 214.3R.

3.13.6 Inspection Before Placing

Foundations, construction joints, forms, and embedded items shall be inspected by the Contractor in sufficient time prior to each concrete placement in order to certify to the Contracting Officer that they are ready to receive concrete. The results of each inspection shall be reported in writing.

3.13.7 Placing

The placing foreman shall supervise placing operations, shall determine that the correct quality of concrete or grout is placed in each location as specified and as directed by the Contracting Officer, and shall be responsible for measuring and recording concrete temperatures and ambient temperature hourly during placing operations, weather conditions, time of placement, volume placed, and method of placement. The placing foreman shall not permit batching and placing to begin until it has been verified that an adequate number of

vibrators in working order and with competent operators are available. Placing shall not be continued if any pile of concrete is inadequately consolidated. If any batch of concrete fails to meet the temperature requirements, immediate steps shall be taken to improve temperature controls.

3.13.8 Vibrators

The frequency and amplitude of each vibrator shall be determined in accordance with COE CRD-C 521 prior to initial use and at least once a month when concrete is being placed. Additional tests shall be made as directed when a vibrator does not appear to be adequately consolidating the concrete. The frequency shall be determined while the vibrator is operating in concrete with the tachometer being held against the upper end of the vibrator head while almost submerged and just before the vibrator is withdrawn from the concrete. The amplitude shall be determined with the head vibrating in air. Two measurements shall be taken, one near the tip and another near the upper end of the vibrator head, and these results averaged. The make, model, type, and size of the vibrator and frequency and amplitude results shall be reported in writing. Any vibrator not meeting the requirements of paragraph Consolidation, shall be immediately removed from service and repaired or replaced.

3.13.9 Curing Inspection

- a. Moist Curing Inspections. At least once each shift, and not less than twice per day on both work and non-work days, an inspection shall be made of all areas subject to moist curing. The surface moisture condition shall be noted and recorded.
- b. Moist Curing Corrective Action. When a daily inspection report lists an area of inadequate curing, immediate corrective action shall be taken, and the required curing period for those areas shall be extended by 1 day.
- c. Membrane Curing Inspection. No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each operation, the Contractor shall estimate the quantity of compound used by measurement of the container and the area of concrete surface covered, shall compute the rate of coverage in square meters per Liter and shall note whether or not coverage is uniform.
- d. Membrane Curing Corrective Action. When the coverage rate of the curing compound is less than that specified or when the coverage is not uniform, the entire surface shall be sprayed again.
- e. Sheet Curing Inspection. At least once each shift and once per day on non-work days, an inspection shall be made of all areas being cured using impervious sheets. The condition of the covering and the tightness of the laps and tapes shall be noted and recorded.
- f. Sheet Curing Corrective Action. When a daily inspection report lists any tears, holes, or laps or joints that are not completely closed, the tears and holes shall promptly be repaired or the sheets replaced, the joints closed, and the required curing period for those areas shall be extended by 1 day.

3.13.10 Cold-Weather Protection

At least once each shift and once per day on non-work days, an inspection shall be made of all areas subject to cold-weather protection. Any deficiencies shall be noted, corrected, and reported.

3.13.11 Mixer Uniformity

- a. Stationary Mixers. Prior to the start of concrete placing and once every 6 months when concrete is being placed, or once for every 60,000 cubic meters of concrete placed, whichever results in the shortest time interval, uniformity of concrete mixing shall be determined in accordance with ASTM C 94.
- b. Truck Mixers. Prior to the start of concrete placing and at least once every 6 months when concrete is being placed, uniformity of concrete mixing shall be determined in accordance with ASTM C 94. The truck mixers shall be selected randomly for testing. When satisfactory performance is found in one truck mixer, the performance of mixers of substantially the same design and condition of the blades may be regarded as satisfactory.
- c. Mixer Uniformity Corrective Action. When a mixer fails to meet mixer uniformity requirements, either the mixing time shall be increased, batching sequence changed, batch size reduced, or adjustments shall be made to the mixer until compliance is achieved.

3.13.12 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. A weekly report shall be prepared for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, reports of pertinent temperatures shall be made daily. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all contractor quality control records.

END OF SECTION

SECTION 03330

CAST-IN-PLACE ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.1 SUMMARY

This section applies to all concrete exposed to view in finished construction in the following locations:

BARRACKS and SCB:

Foundation walls – exposed exterior and interior surfaces as indicated

Interior stair enclosures – all interior wall surfaces

Exterior stairs – vertical and horizontal surfaces as indicated

Interior floors and stair treads – as indicated

COMPANY OPERATIONS

Exterior stairs – vertical surfaces as indicated

Interior walls – as indicated

Interior floors – as indicated

BATTALION HEADQUARTERS

Interior walls – as indicated

Interior floors – as indicated

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI 301	(1996) Standard Specifications for Structural Concrete
ACI 315	(1992) Details and Detailing of Concrete Reinforcement
ACI 318/318R	(1999) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(1995) Building Code Requirements for Structural Concrete and Commentary (Metric)
ACI 347R	(1994) Guide to Formwork for Concrete

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997ael) Carbon Structural Steel

1.3 GENERAL REQUIREMENTS

All materials, procedures, and requirements specified in Section CAST-IN-PLACE STRUCTURAL CONCRETE shall fully apply to cast-in-place architectural concrete, except as otherwise specified.

1.3.1 Design Requirements

1.3.1.1 Concrete Mix

The concrete mix shall be designed in accordance with ACI 211.1 and ACI 211.2. The mix design shall include consideration of the finishes required.

1.3.1.2 Formwork Design

Formwork design shall conform to ACI 301 and ACI 347R.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Architectural Concrete; G

Detail drawings showing details conforming to ACI 315 and ACI 318M ACI 318/318R. Detail drawings shall show location of cast-in-place elements in the work, building elevations, formwork fabrication details, reinforcements, embedments, dimensions, concrete strength, interface with adjacent materials, and special placing instructions, in sufficient detail to cover fabrication, placement, stripping, and finishing.

SD-04 Samples

Materials;
Panels; G

Materials listed below, which shall indicate sizes, shapes, finishes, color, and pertinent accessories:.

Sample panels for vertical construction, located as directed, shall be 2 m long and 1 m high with the thickness to match building conditions for each type of architectural concrete and finish. Panels representing foundation wall construction

may be incorporated with the panels required by SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS. Panel forms shall include a typical joint between form panels, form tie conditions and finishes. Panels shall be protected from weather, and other damage until acceptance of work. Sample panels shall be used as job standards throughout construction.

Color samples on concrete for acid stain system including clear sealer.

1.5 INSTALLER EXPERIENCE

All personnel involved in the application of acid stain shall have previously completed at least 5 projects of similar size and complexity. Lead personnel shall have a minimum of three years experience using the specific products and systems to be employed on this project.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of architectural concrete with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Sample panels are built and provided with all features of the wall construction as indicated.
- (5) Inspection of all formwork prior to concrete placement.
- (6) Protection of finished concrete from damage, surface contamination or staining resulting from the work of other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Aggregates

Aggregates shall conform to requirements for SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. Additional pigments for color added as indicated on drawings.

2.1.2 Reinforcing Steel

Reinforcing steel shall be galvanized if clearance to an exterior face is 25 mm 1 inch or less.

2.1.3 Tie Wire

Tie wire shall be soft monel or 18-8 stainless steel.

2.1.4 Plates, Angles, Anchors, and Embedments

Plates, angles, anchors, and embedments shall conform to ASTM A 36/A 36M, and shall be prime painted with inorganic zinc primer.

2.1.5 Formwork

Formwork for special effects shall be as approved.

2.1.6 Form Release Agents

Form release agents shall be manufacturer's standard, nonstaining, nonpetroleum based, compatible with surface sealer and other finish coatings.

2.1.7 Surface Sealer (floors without acid stain)

Surface sealer shall be methyl methacrylate polymer acrylic emulsion, clear color.

2.1.8 Acid Stain

Reactive stain formulated to permanently and insolubly etch color into new concrete. Submit manufacturer's standard color samples for preliminary selection. Selected color(s) shall be field applied to a test surface matching the actual floor system materials and finish for review and approval by C.O.R. Allow for up to two follow up tests if initial test color/application procedure is unacceptable.

2.1.9 Surface Sealer (over acid stain)

Sealer for use over acid stained floors shall be a product of the stain manufacturer, formulated and approved in writing for the intended use. Sealer shall be acrylic base, non-yellowing, resistant to petroleum products, common acids, wet and dry abrasion and common cleaning chemicals. Solids shall comprise at least 20% of the volume of the sealer.

PART 3 EXECUTION

3.1 FORMWORK ERECTION

Formwork shall be erected in accordance with the detail drawings to ensure that the finished concrete members conform accurately to the indicated dimensions, lines, elevations, and finishes. Deflection shall not exceed 1/360th of each component span or distance between adjacent supports. Deflections and tolerance shall not be cumulative. Form lines shall be installed as necessary to provide the required finish. Forms shall be coated with form release agents before reinforcement is placed. Formwork shall conform to ACI 301, ACI 347R and SECTION: STRUCTURAL CONCRETE FORMWORK.

3.2 CONCRETE FINISHES

3.2.1 Finish type by location:

Minimum finish for any exposed formed concrete is Class A. Minimum finish for floors is troweled. Stair treads shall be broomed. In addition, special finishes shall be provided at the locations listed below and shall conform to the requirements specified herein.

BARRACKS and SCB

Foundation wall (exterior): Sandblast finish

Foundation wall (interior), stair enclosure walls and exterior stair risers: Smooth finish using smooth nonporous forms

Exterior Stairs (horizontal surfaces): Broom finish

Interior Floors (exposed in finished construction): Acid stain and sealer

COMPANY OPERATIONS

Interior walls and ceilings and exterior stair risers: Smooth finish using smooth non-porous forms.

Exterior Stairs (horizontal surfaces): Broom finish

BATTALION HEADQUARTERS

Interior walls: Smooth finish using smooth non-porous forms.

Concrete finishes shall conform to the approved finishes. Finishing shall be accomplished at the time of concrete placement or immediately after formwork removal. Cast-in-place concrete elements, that are to have a finish other than the surface produced from standard formwork, shall be accomplished by using the following procedures.

3.2.2 Smooth Finish

After other concrete construction is complete and each overall separate contiguous area of the structure, smooth finish shall be applied to the areas indicated on drawings and/or listed in this section. A mortar mix consisting of one part Portland cement and two parts well-graded sand passing a 0.6 mm No. 30 sieve, with water added to give the consistency of thick paint, shall be used. Where the finished surface will not receive other applied surface, white cement shall be used to replace part of the job cement to produce an approved color, which shall be uniform throughout the surfaces of the structure. After the surface has been thoroughly wetted and allowed to approach surface dryness, the mortar shall be vigorously applied to the area by clean burlap pads or by cork or wood floating, to completely fill all surface voids. Excess grout shall be scraped off with a trowel. As soon as it can be accomplished without pulling the mortar from the voids, the area shall be rubbed with burlap pads having on their surface the same sand-cement mix specified above but without any mixing water, until all of the visible grout film is removed. The burlap pads used for this operation shall be stretched tightly around a board to prevent dishing the mortar in the voids.

The finish of any area shall be completed in the same day, and the limits of a finished area shall be made at natural breaks in the surface. The surface shall be continuously moist cured for 48 hours commencing immediately after finishing operations in each area. The temperature of the air adjacent to the surface shall be not less than 10 degrees C for 24 hours prior to, and 48 hours after, the application. In hot, dry weather the smooth finish shall be applied in shaded areas or at night, and shall never be applied when there is significant hot, dry wind.

3.2.3 Sandblast Finish

The concrete surface shall be blasted at an approved age with approved wet sandblasting procedures to obtain a light finish that will match the descriptive photographs in ACI 303R. The finish shall be similar to and shall closely match the finish on the approved pre-construction test panel fabricated by the Contractor.

3.2.4 Acid Stain and Sealer

Floors at Barracks corridors and interior stairs that are exposed in final construction shall be finished with a penetrating acid stain. Follow manufacturer's instructions for preparation of surface and application of stain, including initial cure period of new concrete. Verify potential prohibitions of liquid curing agents on floor zones to be stained. Coordinate required joint preparation of floor. Floors shall be finished with a hard, clear sealer. Sealer shall be applied in two or more thin coats to develop the required thickness/coverage.

3.3 JOINT SEALING

Joint sealing shall be as specified in Section 07900 JOINT SEALING.

3.4 CLEANING

No sooner than 72 hours after joints are sealed, faces and other exposed surfaces of cast-in-place concrete shall be washed down, cleaned with soap and water applied with a soft bristle brush, then washed down again with clean water, or by other approved procedures. Discolorations that cannot be removed by these procedures shall be considered defective work. Cleaning work shall be done when temperature and humidity conditions are such that surfaces dry rapidly. Care shall be taken during cleaning operations to protect adjacent surfaces from damage.

3.5 SURFACE SEALING

After cleaning, exterior and interior exposed architectural concrete surfaces indicated (except for acid stained floor areas) shall be given one coat of surface sealer, spray applied unless otherwise approved. Acid stained areas shall receive the number of sealer coats directed by the stain manufacturer. Adjacent surfaces shall be protected to prevent damage from the surface sealer.

3.6 PROTECTION OF WORK

Work shall be protected against damage from subsequent operations. Provide continuous protection of all acid stained surface against contamination by other construction materials.

3.7 DEFECTIVE WORK

Defective work shall be repaired or replaced, as directed, using approved procedures.

END OF SECTION

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SECTION 03413

PRECAST ARCHITECTURAL CONCRETE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI 211.1	(1991) Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 211.2	(1998) Standard Practice for Selecting Proportions for Structural Lightweight Concrete
ACI Detailing Mnl	(1994) ACI Detailing Manual: Section Details and Detailing of Concrete Reinforcement
ACI 318/318R	(1995) Building Code Requirements for Structural Concrete and Commentary
ACI 318M	(1995) Metric Building Code Requirements for Structural Concrete and Commentary

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 416/A 416M	(1997) Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 1017	(1997) Chemical Admixtures for Use in Producing Flowing Concrete

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structured Welding Code - Steel
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PRECAST/PRESTRESSED CONCRETE INSTITUTE (PCI)

PCI Mnl-116S	(1985) Manual for Quality Control for Plants and Production of Precast and Prestressed Concrete Products
PCI Mnl-117	(1996) Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products

PCI Mnl-122

(1989) Architectural Precast Concrete

1.2 GENERAL REQUIREMENTS

Precast concrete units shall be designed and fabricated by an experienced and acceptable precast concrete manufacturer certified under the PCI Plant Certification Program. The manufacturer shall have been regularly and continuously engaged in the manufacture of precast concrete work similar to that indicated on the drawings for at least 3 years. Precast work shall be coordinated with the work of other trades.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Architectural Concrete System; G

Detail drawings showing details in accordance with ACI Detailing Manual and ACI 318M ACI 318/318R, including installation details. Detail drawings shall indicate separate identification marks for each different precast unit, location of units in the work, elevations, fabrication details, welding details, reinforcement, connections, dimensions, interface with adjacent members, blocking points for units stored at the precast concrete plant or at the jobsite, lifting points and special handling instructions in sufficient detail to cover manufacture, handling, and erection.

SD-03 Product Data

Calculations;

Design calculations, prior to the manufacture of any precast architectural concrete units for the project.

Mix Design;

A statement giving the maximum nominal coarse aggregate size, the proportions of all ingredients and the type and amount of any admixtures that will be used in the manufacture of each strength and type of concrete, prior to commencing operations. The statement shall be accompanied by test results from an approved testing laboratory, certifying that the proportions selected will produce concrete of the properties required. No substitutions shall be made without additional tests to verify that the concrete properties are satisfactory.

Manufacturer and Installer Qualifications; G

A statement giving the qualifications of the precast concrete manufacturer and of the installers, prior to commencing operations.

SD-04 Samples

Precast Concrete Units;

Two 300 by 300 by 50 mm samples of each type of precast unit finish required for the project. Samples shall show matrix color, surface color, surface texture, and panel back finish. A partial window sill unit shall be included in the sample panels required by SECTION: NON-BEARING MASONRY VENEER/STEEL STUD WALLS.

SD-06 Test Reports

Materials; G

Certified copies of test reports including all test data and all test results. Tests for compressive strength of concrete shall be performed by an approved independent commercial testing laboratory, except that compressive strength tests for initial prestress may be performed in the manufacturer's plant laboratory.

1.4 DESIGN

1.4.1 Standards and Loads

Precast unit design shall conform to ACI 318M ACI 318/318R and PCI Mnl-122. Design loads for precast concrete shall be as indicated on the drawings. A differential temperature of 89 degrees C 160 degrees F, between interior and exterior faces of the units, shall be considered in the design. Stresses due to restrained volume change caused by shrinkage and temperature differential, handling, transportation and erection shall be accounted for in the design.

1.4.2 Connections

Connection of units to other members, or to other units shall be of the type and configuration indicated. The design and sizing of connections for all design loads shall be by the Contractor.

1.4.3 Concrete Strength

Precast concrete units shall have a 28-day compressive strength of 34 MPa (5000 psi).

1.4.4 Concrete Proportion

Selection of proportions for concrete shall be based on the methodology presented in ACI 211.1 for normal weight concrete and ACI 211.2 for lightweight concrete. The concrete proportion shall be developed using the same type and brand of cement, the same type and gradation of aggregates, and the same type and brand of admixture that will be used in the manufacture of precast concrete units for the project. Calcium chloride shall not be used in precast concrete.

1.4.5 Calculations

Calculations for design of members and connections not shown shall be made by a professional engineer experienced in the design of precast architectural concrete. Calculation shall include the analysis of member for lifting stresses and the sizing of the lifting inserts.

1.5 STORAGE AND INSPECTION AT MANUFACTURER'S PLANT

Precast units temporarily stored at the manufacturer's plant shall be protected from damage in accordance with PCI Mnl-116S and PCI Mnl-117 and PCI Mnl-122. Immediately prior to shipment to the jobsite, all precast concrete units shall be inspected for quality to insure all precast units conform to the requirements specified. Inspection for quality shall include, but shall not necessarily be limited to, the following elements: color, texture, dimensional tolerances, chipping, cracking, staining, warping and honeycombing. All defective precast concrete units shall be replaced or repaired as approved.

1.6 HANDLING AND STORAGE

Precast units shall be delivered to the site in accordance with delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite all precast units shall be inspected for quality as specified above. If the precast units cannot be unloaded and placed directly into the work, they shall be stored onsite, off the ground and protected from weather, marring, or overload. Precast units shall be handled in accordance with manufacturer's instructions.

1.7 MANUFACTURER AND INSTALLER EXPERIENCE

The precast manufacturer shall meet the following experience and capability requirements. If the installation contractor is a separate entity from the manufacturer, it shall also meet the same requirements.

- (1) Regularly and presently fabricates and erects precast concrete architectural components as a principal product/service.
- (2) Has a minimum of 5 years successful experience in the fabrication of architectural precast concrete units similar to the units required for this project (submit names of at least five previous projects).
- (3) Possess sufficient production capacity to produce, transport and deliver the required units without causing delay in the work.
- (4) Has a minimum of 2 years successful experience in the erection of precast units similar to the units required for this project.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of precast concrete construction with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Precast concrete units meet all requirements for shape, size, strength, mix design, etc.
- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Precast concrete units are incorporated in sample panels with all features of the wall construction as indicated.
- (6) Precast concrete unit installation is coordinated with interfacing construction to eliminate conflicts.
- (7) Precast manufacturer meets all required qualifications for design and fabrication.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Except as otherwise specified, material shall conform to SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE and SECTION: CONCRETE REINFORCEMENT.

2.1.1 Aggregates

Aggregates shall be ½ inch to No. 4 nominal-size coarse aggregate. Coarse aggregate shall be 3/8 inch Ivory Marble. Fine aggregates shall be Eagle Gray marble and Lapis Lustre sand.

2.1.2 Cement

Cement shall be White Cement conforming to ASTM C 150, Type I or Type III.

2.1.3 Reinforcing Steel

Reinforcing steel shall be galvanized if clearance to an exterior face is 25 mm or less.

2.1.4 Tie Wire

Tie wire shall be soft monel or 18-8 stainless steel.

2.1.5 Inserts

Inserts shall be manufacturer's standard, suited for the application.

2.1.6 Plates, Angles, Anchors and Embedments

Material shall be as specified in PCI Mnl-117. Steel items, other than stainless, shall be coated with a rust-inhibiting paint or shall be hot-dip galvanized. Steel items, including items embedded in concrete, shall be either stainless steel or hot dip galvanized steel.

2.1.7 Form Release Agent

Release agent shall be manufacturer's standard nonstaining type.

2.1.8 Admixtures

Admixtures shall conform to ASTM C 494. Plasticizing admixture, if used, shall conform to ASTM C 1017.

2.2 PRECAST CONCRETE UNITS

Precast concrete units shall be manufactured and cured in accordance with the applicable provisions of PCI Mnl-116S and PCI Mnl-117. Units shall be manufactured within the allowable tolerances given in PCI Mnl-117 and PCI Mnl-122.

2.2.1 Formwork

Forms shall be steel of adequate thickness, braced, stiffened, anchored and aligned to produce precast architectural concrete units within required dimensional tolerances. Forms shall be sufficiently rigid to provide dimensional stability during handling and concrete placement and consolidation. Fiberglass-reinforced plastic, plastic coated wood, elastomeric or other nonabsorptive material shall be used for making tight joints and rustication pieces.

2.2.2 Reinforcement

Fabrication and placement of reinforcement shall conform to the details shown on the approved detail drawings and PCI Mnl-117.

2.2.3 Embedded Accessories

Anchors, inserts, lifting devices, and other accessories which are to be embedded in the precast units shall be furnished and installed in accordance with the approved detail drawings. Embedded items shall be accurately positioned in their designed location, and shall have sufficient anchorage and embedment to satisfy design requirements.

2.2.4 Stripping

Precast concrete units shall not be removed from forms until units develop sufficient strength to safely strip the formwork and to remove the precast concrete units from the forms to prevent damage to the units from overstress or chipping.

2.2.5 Identification

Each precast concrete unit shall be marked to correspond to the identification marks for each different precast unit shown on the detail drawings.

2.2.6 Finishes

2.2.6.1 Exposed Surfaces

Surfaces of precast units exposed to view, or surfaces indicated to be finished shall be finished as follows:

- (1) At unit terminations, edges and corner transitions, grind smooth form offsets and fins over 5-mm projection. Fill air holes and pockets over 5-mm diameter with sand cement paste. Complete prior to acid washing.
- (2) All curved surfaces shall be free of flat spots or other surface irregularities.
- (3) Unit surfaces exposed to view shall receive a medium acid wash. Acid wash procedures shall be as recommended in PCI Mnl-117, "Acid Etched", for a uniform surface appearance.
- (4) Concealed concrete surfaces shall receive a standard "underside" finish. This shall be the normal plant run finish produced in forms that impart a smooth finish to the concrete. Small surface holes caused by air bubbles, normal form joint marks, monitor chips and spalls will be tolerated, but not major or unsightly imperfections, honeycomb or structural defects.

2.2.6.2 Other Surfaces

Surfaces of precast units not exposed to view or not otherwise indicated to be finished shall be finished in accordance with SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE.

2.2.7 Liquid Water Repellant

Clear penetrating coating that reacts with concrete surfaces to form a chemical water repellent bond; water based alkylalkoxysilane (20 percent by weight); applied in the field by an applicator approved in writing by the material manufacturer in accordance with the manufacturer's directions. Coating shall have a water absorption rate of not more than 0.53 percent in 48 hours when tested in accordance with ASTM C642-82. Coating shall not inhibit adhesion of sealants specified in SECTION: JOINT SEALING.

PART 3 EXECUTION

3.1 INSPECTION

Contractor shall examine all portions of the supporting structure and the conditions under which the precast concrete work is to be erected and notify the Contracting Officer in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in an acceptable manner.

3.2 ERECTION

3.2.1 Prohibitions

Do not install precast concrete units until at least 5 days after casting. Do not use powder-actuated fasteners for surface attachment of accessory items in any precast unit. Do not block air cavity of masonry veneer walls.

3.2.2 Installation

Precast units shall be erected in accordance with the detail drawings and without damage to other units or to adjacent members. Units shall be set true to alignment and level, with joints properly spaced and aligned both vertically and horizontally. Erection tolerances shall be in accordance with the requirements of PCI Mnl-117 and PCI Mnl-122. As units are being erected, shims and wedges shall be placed as required to maintain position, stability and correct alignment. After final attachment, precast units shall be grouted as shown on detail drawings. After erection, welds and abraded surfaces of steel shall be cleaned and touched-up with a zinc-rich paint. Welds shall be made by a certified welder in accordance with the manufacturer's erection drawings. Pickup points, erection aids, boxouts, inserts, and similar items shall be removed as necessary and finished to match adjacent areas after erection. Hardware shall be recessed on any surfaces exposed at completion. Erection of precast units shall be supervised and performed by workmen skilled in this type of work. Welding and the qualifications of welders shall be in accordance with AWS D1.1.

3.2.3 Precast Components in Masonry Veneer Walls

Precast units used in conjunction with masonry construction shall be sized to meet the dimensional modules of the adjacent masonry. Provide expansion joints where precast units cross similar joints in masonry construction. Precast units shall be incorporated in construction concurrently with adjacent masonry units. Joints between precast and masonry units shall be masonry mortar with matching surface strike. Anchor precast units to steel studs or structural members using methods similar to those required for masonry and incorporating the same tolerances and requirements for movement as masonry veneer anchors.

3.3 JOINT SEALING

Joint sealing between precast units shall be as specified in SECTION: JOINT SEALING.

3.4 APPLICATION OF LIQUID WATER REPELLENT

Apply repellent after completion of adjoining elastomeric sealant work and initial cleaning of units. Apply material in accordance with manufacturer's printed instructions. Mask adjacent areas to avoid contamination of masonry, glass, EIFS and other adjacent surfaces. After 21 days, spray water on coated surfaces and recoat any absorptive surfaces.

3.5 CLEANING

Not sooner than 72 hours after joints are sealed, faces and other exposed surfaces of precast concrete discolored during erection shall be cleaned to remove dirt and stains by dry scrubbing with a stiff fiber brush, wetting the surface and vigorous scrubbing of the finish with

a stiff fiber brush followed by additional washing, or by chemical cleaning compounds such as detergents or other commercial cleaners. Do not use cleaning materials or processes that could change the character of the exposed concrete finishes. Commercial cleaners shall be used in accordance with the manufacturer's recommendations. Cleaning procedure shall be performed on a designated test area and shall be approved prior to proceeding with cleaning work. Discolorations that cannot be removed by these procedures, will be considered defective work. Cleaning work shall be done when temperature and humidity permit surfaces to dry rapidly. Adjacent surfaces shall not be damaged during cleaning operations.

3.6 PROTECTION OF WORK

Precast units shall be protected against damage from subsequent operations.

3.7 DEFECTIVE WORK

Conduct inspections, perform testing, and make repairs or replace unsatisfactory precast units as required. Precast concrete units that do not conform to the specified requirements, including strength, tolerances and finishes, shall be replaced with conforming units. Precast concrete units damaged during erection shall be repaired as soon after occurrence as possible or replaced, as directed by Contracting Officer, using approved procedures. All repairs to precast concrete units shall match the adjacent surfaces in color and texture and shall be as approved. Unless otherwise approved, repair procedures shall conform to PCI Mnl-117. In-place precast units may be rejected for any one of the following:

- (1) Exceeding the specified installation tolerances.
- (2) Damage during construction operations.
- (3) Exposed to view surfaces that develop surface finish deficiencies.
- (4) Patching work visible from ground or through windows.
- (5) Other defects as listed in PCI Mnl-117.

END OF SECTION

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SECTION 04200

MASONRY

PART 1 GENERAL

1.1 SCOPE OF WORK

Masonry construction specified in this section includes brick veneer on concrete walls and concrete masonry unit veneer on foundation walls. Brick veneer on steel stud walls is specified in SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ACI INTERNATIONAL (ACI)

ACI SP-66 (1994) ACI Detailing Manual

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 82 (1997a) Steel Wire, Plain, for Concrete Reinforcement

ASTM A 153/A 153M (2000) Zinc Coating (Hot-Dip) on Iron and Steel Hardware

ASTM A 615/A 615M (2000) Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

ASTM C 55 (1999) Concrete Brick

ASTM C 62 (2000) Building Brick (Solid Masonry Units Made from Clay or Shale)

ASTM C 67 (2000) Sampling and Testing Brick and Structural Clay Tile

ASTM C 90 (2000) Loadbearing Concrete Masonry Units

ASTM C 91 (1999) Masonry Cement

ASTM C 126 (1999) Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units

ASTM C 129 (2000) Nonloadbearing Concrete Masonry Units

ASTM C 140 (1999b) Sampling and Testing Concrete Masonry Units

ASTM C 216	(2000) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(2000) Mortar for Unit Masonry
ASTM C 476	(1999) Grout for Masonry
ASTM C 494/C 494M	(1999a) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 641	(1982; R 1998el) Staining Materials in Lightweight Concrete Aggregates
ASTM C 652	(2000a) Hollow Brick (Hollow Masonry Units Made From Clay or Shale)
ASTM C 744	(1999) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(2000) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 1019	(2000) Sampling and Testing Grout
ASTM C 1072	(2000) Measurement of Masonry Flexural Bond Strength
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2240	(2000) Rubber Property - Durometer Hardness
ASTM D 2287	(1996a) Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 447	(1997) Compressive Strength of Masonry Prisms

1.3 RELATED WORK

Masonry veneer on steel studs - SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.
Concrete materials - SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE.
Precast concrete - SECTION: PRECAST ARCHITECTURAL CONCRETE.
CMU sealer – SECTION: PAINTING, GENERAL
Insulation – SECTION: BUILDING INSULATION

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Masonry Work; G,

Drawings including plans, elevations, and details of wall reinforcement; details of reinforcing bars at corners and wall intersections; offsets; tops, bottoms, and ends of walls; control and expansion joints; and wall openings. Bar splice locations shall be shown. If the Contractor opts to furnish inch-pound CMU products, drawings showing elevation of walls exposed to view and indicating the location of all cut CMU products shall be submitted for approval. Bent bars shall be identified on a bending diagram and shall be referenced and located on the drawings. Wall dimensions, bar clearances, and wall openings greater than one masonry unit in area shall be shown. No approval will be given to the shop drawings until the Contractor certifies that all openings, including those for mechanical and electrical service, are shown. If, during construction, additional masonry openings are required, the approved shop drawings shall be resubmitted with the additional openings shown along with the proposed changes. Location of these additional openings shall be clearly highlighted. The minimum scale for wall elevations shall be 1 to 50. Reinforcement bending details shall conform to the requirements of ACI SP-66.

SD-03 Product Data

Clay or Shale Brick; G, Concrete Masonry Units (CMU) Prefaced Concrete Masonry Units; G

Manufacturer's descriptive data.

Cold Weather Installation; G,

Cold weather construction procedures.

SD-04 Samples

Concrete Masonry Units (CMU); G, Prefaced Concrete Masonry Units; G, Clay or Shale Brick; G

Color samples of three stretcher units and one unit for each type of special shape. Units shall show the full range of color and texture.

Anchors, Ties, and Bar Positioners; G

Two of each type used.

Expansion-Joint Material; G

One piece of each type used.

Joint Reinforcement; G

One piece of each type used, including corner and wall intersection pieces, showing at least two cross wires.

SD-06 Test Reports

Efflorescence Test; G, Field Testing of Mortar; G, Field Testing of Grout; G, Prism tests; G, Masonry Cement; G,

Test reports from an approved independent laboratory. Test reports on a previously tested material shall be certified as the same as that proposed for use in this project.

Special Inspection; G

Copies of masonry inspector reports.

SD-07 Certificates

Clay or Shale Brick; Concrete Masonry Units (CMU); Prefaced Concrete Masonry Units;

Certificates of compliance stating that the materials meet the specified requirements.

1.5 SAMPLE MASONRY PANELS

After material samples are approved and prior to starting masonry work, sample masonry panels shall be constructed for each type and color of masonry required. At least 48 hours prior to constructing the sample panel or panels, the Contractor shall submit written notification to the Contracting Officer's Representative. Sample panels shall not be built in, or as part of the structure, but shall be located where directed. Where materials specified in this section are installed adjacent to veneer wall construction, they may be included in sample panels specified in SECTION: NONBERARING MASONRY VENEER/STEEL STUD WALLS.

1.5.1 Configuration

Panels shall be L-shaped or otherwise configured to represent all of the wall elements. Panels shall be of the size necessary to demonstrate the acceptable level of workmanship for each type of masonry represented on the project. The minimum size of a straight panel or a leg of an L-shaped panel shall be 2.5 m long by 1.8 m high.

1.5.2 Composition

Panels shall show full color range, texture, and bond pattern of the masonry work. The Contractor's method for mortar joint tooling; grouting of reinforced vertical cores, collar joints,

bond beams, and lintels; positioning, securing, and lapping of reinforcing steel; positioning and lapping of joint reinforcement (including prefabricated corners); and cleaning of masonry work shall be demonstrated during the construction of the panels. Installation or application procedures for anchors, wall ties, glass block units, CMU control joints, brick expansion joints, insulation, flashing, brick soldier, row lock courses and weep holes shall be shown in the sample panels. The panels shall contain a masonry bonded corner that includes a bond beam corner. Panels shall show parging and installation of electrical boxes and conduit. Panels that represent reinforced masonry shall contain a 600 by 600 mm opening placed at least 600 mm above the panel base and 600 away from all free edges, corners, and control joints. Required reinforcing shall be provided around this opening as well as at wall corners and control joints.

1.5.3 Construction Method

Where anchored veneer walls are required, the Contractor shall demonstrate and receive approval for the method of construction; i.e., either bring up the two wythes together or separately, with the insulation and appropriate ties placed within the specified tolerances across the cavity. Temporary provisions shall be demonstrated to preclude mortar or grout droppings in the cavity and to provide a clear open air space of the dimensions shown on the drawings. Where masonry is to be grouted, the Contractor shall demonstrate and receive approval on the method that will be used to bring up the masonry wythes; support the reinforcing bars; and grout cells, bond beams, lintels, and collar joints using the requirements specified herein. If sealer is specified to be applied to the masonry units, sealer shall be applied to the sample panels. Panels shall be built on a properly designed concrete foundation.

1.5.4 Usage

The completed panels shall be used as the standard of workmanship for the type of masonry represented. Masonry work shall not commence until the sample panel for that type of masonry construction has been completed and approved. Panels shall be protected from the weather and construction operations until the masonry work has been completed and approved. After completion of the work, the sample panels, including all foundation concrete, shall become the property of the Contractor and shall be removed from the construction site.

1.6 DELIVERY, HANDLING, AND STORAGE

Materials shall be delivered, handled, stored, and protected to avoid chipping, breakage, and contact with soil or contaminating material.

1.6.1 Masonry Units

Concrete masonry units shall be covered or protected from inclement weather. In addition, glass block units and prefaced concrete units shall be stored with their finish surfaces covered. Prefabricated lintels shall be marked on top sides to show either the lintel schedule number or the number and size of top and bottom bars.

1.6.2 Reinforcement, Anchors, and Ties

Steel reinforcing bars, coated anchors, ties, and joint reinforcement shall be stored above the ground. Steel reinforcing bars and uncoated ties shall be free of loose mill scale and rust.

1.6.3 Cementitious Materials, Sand and Aggregates

Cementitious and other packaged materials shall be delivered in unopened containers, plainly marked and labeled with manufacturers' names and brands. Cementitious material shall be stored in dry, weathertight enclosures or be completely covered. Cement shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness. Sand and aggregates shall be stored in a manner to prevent contamination or segregation.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of masonry with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Brick and concrete masonry units meet all requirements for shape, size, strength, etc.
- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Sample panels are built and provided with all features of the wall construction as indicated.
- (6) Masonry installation is coordinated with interfacing construction to eliminate conflicts.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

The source of materials which will affect the appearance of the finished work shall not be changed after the work has started except with Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) CMU products. If the Contractor decides to substitute inch-pound CMU products, the following additional requirements shall be met:

- a. The metric dimensions indicated on the drawings shall not be altered to accommodate inch-pound CMU products either horizontally or vertically. The 100 mm building module shall be maintained, except for the CMU products themselves.
- b. Mortar joint widths shall be maintained as specified.
- c. Rebar shall not be cut, bent or eliminated to fit into the inch-pound CMU products module.

- d. Brick and inch-pound CMU products shall not be reduced in size by more than one-third (1/3) in height and one-half (1/2) in length. Cut CMU products shall not be located at ends of walls, corners, and other openings.
- e. Cut, exposed brick and CMU products shall be held to a minimum and located where they would have the least impact on the architectural aesthetic goals of the facility.
- f. Other building components, built into the CMU products, such as window frames, door frames, louvers, grilles, fire dampers, etc., that are required to be metric, shall remain metric.
- g. Additional metric guidance shall conform to SECTION: METRIC MEASUREMENTS.

2.2 CLAY OR SHALE BRICK

Color range and texture of clay or shale brick shall be as indicated and shall conform to the approved sample. Grade SW shall be used for brick in contact with earth or grade and for all exterior work. Grade SW or MW shall be used in other brickwork. Brick shall be tested for efflorescence. Clay or shale brick units shall be delivered factory-blended to provide a uniform appearance and color range in the completed wall.

2.2.1 Solid Clay or Shale Brick

As specified in SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.

2.2.2 Hollow Clay or Shale Brick

As specified in SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.

2.3 CONCRETE BRICK

Concrete brick shall conform to ASTM C 55, Type I, Grade N-I. Concrete brick may be used where necessary for filling out in concrete masonry unit construction.

2.4 CONCRETE MASONRY UNITS (CMU)

Hollow and solid concrete masonry units shall conform to ASTM C 90. Cement shall have a low alkali content and be of one brand.

2.4.1 Aggregates

Lightweight aggregates and blends of lightweight and heavier aggregates in proportions used in producing the units, shall comply with the following requirements when tested for stain-producing iron compounds in accordance with ASTM C 641: by visual classification method, the iron stain deposited on the filter paper shall not exceed the "light stain" classification.

2.4.2 Kinds and Shapes

Units shall be modular in size and shall include closer, jamb, header, lintel, and bond beam units and special shapes and sizes to complete the work as indicated. In exposed interior

masonry surfaces, units having a bullnose shall be used for vertical external corners except at door, window, and louver jambs. Radius of the bullnose shall be 25 mm. Units used in exposed masonry surfaces in any one building shall have a uniform fine to medium texture and a uniform color.

2.4.2.1 Architectural Units

Units shall have patterned face shell. Face shell pattern shall be split face and smooth face. Units shall be integrally colored during manufacture. Color shall be as indicated on drawings. Patterned face shell shall be properly aligned in the completed wall.

2.4.3 Horizontal Joint Reinforcement

Joint reinforcement shall be factory fabricated from steel wire, and shall conform to ASTM A 82. Wire shall be zinc coated after fabrication by the hot-dip process conforming to ASTM A 153/A 153M, Class B-2. Reinforcement shall consist of two or more parallel longitudinal wires not lighter than 9 gauge weld connected with cross wires not lighter than 14 gauge at not greater than 200 mm on center. At least one longitudinal wire for each face of glass block shall be provided. Out-to-out dimension of the longitudinal wires shall be 40 mm less than the actual width of the block. Joint reinforcement in flat sections not less than 2.40 m long shall be provided, except that corner reinforcements and other special shapes may be shorter.

2.4.4 Strip Anchor

Perforated steel strip shall be not less than 20 gauge, minimum of 45 mm (1-3/4 inches) wide by 600 mm (24 inches) long and galvanized after fabrication.

2.4.5 Wire-Type Anchor

Steel wire shall be not less than 9 gauge of approved design suitable for use with the panel stiffener provided and galvanized after fabrication.

2.4.6 Expansion Strip

Dense fibrous glass batt or material shall be as recommended by the glass block manufacturer.

2.4.7 Packing (Backer Rods)

Polyethylene foam, neoprene, or filler shall be as recommended by the sealant manufacturer.

2.5 MORTAR

Mortar shall be Type S in accordance with the proportion specification of ASTM C 270 except Type S cement-lime mortar proportions shall be 1 part cement, 1/2 part lime and 4-1/2 parts aggregate. When masonry cement ASTM C 91 is used the maximum air content shall be limited to 12 percent and performance equal to cement-lime mortar shall be verified. Verification of masonry cement performance shall be based on ASTM C 780 and ASTM C 1072. Mortar for prefaced concrete masonry unit wainscots shall contain aggregates with 100 percent passing the 2.36 mm (No. 8) sieve and 95 percent passing the 1.18 mm (No. 16)

sieve. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source.

2.5.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.5.2 Coloring

Mortar coloring shall be added to the mortar used for exposed masonry surfaces to produce a uniform color as indicated on drawings. Mortar coloring shall not exceed 3 percent of the weight of cement for carbon black and ten percent of the weight of cement for all other pigments. Mortar coloring shall be chemically inert, of finely ground limeproof pigment, and furnished in accurately pre-measured and packaged units that can be added to a measured amount of cement.

2.6 GROUT

Grout shall conform to ASTM C 476. Cement used in grout shall have a low alkali content. Grout slump shall be between 200 and 250 mm. (8 and 10 inches.) Grout shall be used subject to the limitations of Table III. Proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in grout for the work unless additional evidence is furnished that the grout meets the specified requirements.

2.6.1 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixture shall be non-corrosive, shall contain less than 0.2 percent chlorides, and shall conform to ASTM C 494/C 494M, Type C.

2.6.2 Grout Barriers

Grout barriers for vertical cores shall consist of fine mesh wire, fiberglass, or expanded metal.

2.7 ANCHORS, TIES, AND BAR POSITIONERS

Anchors and ties shall be fabricated without drips or crimps and shall be zinc-coated in accordance with ASTM A 153/A 153M, Class B-2. Steel wire used for anchors and ties shall be fabricated from steel wire conforming to ASTM A 82. Anchors and ties shall be sized to provide a minimum of 16 mm mortar cover from either face.

2.7.1 Wire Mesh Ties

Wire mesh for tying 100 mm thick concrete masonry unit partitions to other intersecting masonry partitions shall be 13 mm mesh of minimum 16 gauge steel wire. Minimum lengths shall be not less than 300 mm.

2.7.2 Wall Ties

Wall ties shall be rectangular-shaped or Z-shaped fabricated of 5 mm diameter zinc-coated steel wire. Rectangular wall ties shall be no less than 100 mm wide. Wall ties may also be of a continuous type conforming to paragraph JOINT REINFORCEMENT. Adjustable type wall ties, if approved for use, shall consist of two essentially U-shaped elements fabricated of 5 mm diameter zinc-coated steel wire. Adjustable ties shall be of the double pintle to eye type and shall allow a maximum of 13 mm eccentricity between each element of the tie. Play between pintle and eye opening shall be not more than 2 mm. The pintle and eye elements shall be formed so that both can be in the same plane.

2.7.3 Dovetail Anchors

Dovetail anchors shall be of the flexible wire type, 5 mm diameter zinc-coated steel wire, triangular shaped, and attached to a 12 gauge or heavier steel dovetail section. These anchors shall be used for anchorage of veneer wythes or composite-wall facings extending over the face of concrete columns, beams, or walls. Cells within vertical planes of these anchors shall be filled solid with grout for full height of walls or partitions, or solid units may be used. Dovetail slots are specified in SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE.

2.7.4 Adjustable Anchors

Adjustable anchors shall be 5 mm diameter steel wire, triangular-shaped. Anchors attached to steel shall be 8 mm diameter steel bars placed to provide 2 mm play between flexible anchors and structural steel members. Spacers shall be welded to rods and columns. Equivalent welded-on steel anchor rods or shapes standard with the flexible-anchor manufacturer may be furnished when approved. Welds shall be cleaned and given one coat of zinc-rich touch up paint.

2.7.5 Bar Positioners

Bar positioners, used to prevent displacement of reinforcing bars during the course of construction, shall be factory fabricated from 9 gauge steel wire or equivalent, and coated with a hot-dip galvanized finish. Not more than one wire shall cross the cell.

2.8 JOINT REINFORCEMENT

Joint reinforcement shall be factory fabricated from steel wire conforming to ASTM A 82, welded construction. Tack welding will not be acceptable in reinforcement used for wall ties. Wire shall have zinc coating conforming to ASTM A 153/A 153M, Class B-2. All wires shall be a minimum of 9 gauge. Reinforcement shall be ladder type design, having one longitudinal wire in the mortar bed of each face shell for hollow units and one wire for solid units. Joint reinforcement shall be placed a minimum of 16 mm cover from either face. The distance between crosswires shall not exceed 400 mm. Joint reinforcement for straight runs shall be furnished in flat sections not less than 3 m long. Joint reinforcement shall be provided with factory formed corners and intersections. If approved for use, joint reinforcement may be furnished with adjustable wall tie features.

2.9 REINFORCING STEEL BARS AND RODS

Reinforcing steel bars and rods shall conform to ASTM A 615/A 615M, Grade 60.

2.10 CONTROL JOINT KEYS

Control joint keys shall be a factory fabricated solid section of natural or synthetic rubber (or combination thereof) conforming to ASTM D 2000 or polyvinyl chloride conforming to ASTM D 2287. The material shall be resistant to oils and solvents. The control joint key shall be provided with a solid shear section not less than 16 mm thick and 10 mm thick flanges, with a tolerance of plus or minus 2 mm. The control joint key shall fit neatly, but without forcing, in masonry unit jamb sash grooves. The control joint key shall be flexible at a temperature of minus 34 degrees C after five hours exposure, and shall have a durometer hardness of not less than 70 when tested in accordance with ASTM D 2240.

2.11 EXPANSION-JOINT MATERIALS

Backer rod and sealant shall be adequate to accommodate joint compression equal to 50 percent of the width of the joint. The backer rod shall be compressible rod stock of polyethylene foam, polyurethane foam, butyl rubber foam, or other flexible, nonabsorptive material as recommended by the sealant manufacturer. Sealant shall conform to SECTION: JOINT SEALING.

2.12 FLASHING

Flashing material shall be copper or stainless steel sheet. Copper meeting ASTM B370, minimum 450 g (16 ounce) weight. Stainless steel meeting ASTM 167, Type 304, minimum 0.4 mm (0.015 inch) thickness. Provide with factory fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations. Flashing installation practices shall conform to detailing contained on drawings and as specified in this section and SECTION: SHEET METALWORK, GENERAL.

2.13 WEEP HOLE VENTILATORS

Weep hole ventilators shall be prefabricated aluminum grill type vents designed to prevent insect entry with maximum air entry. Ventilators shall be sized to match modular construction with a standard 10 mm (3/8 inch) mortar joint.

2.14 LIQUID WATER REPELLANT COATING

Water repellant shall be a clear penetrating coating that reacts with concrete and masonry surfaces to form a chemical water repellent bond; water based alkylalkoxysilane (20 percent by weight, minimum); applied in the field by an applicator approved in writing by the material manufacturer in accordance with the manufacturer's directions. Coating shall have a water absorption rate of not more than 0.53 percent in 48 hours when tested in accordance with ASTM C642-82. Coating shall not inhibit adhesion of sealants specified in SECTION: JOINT SEALING.

PART 3 EXECUTION

3.1 ENVIRONMENTAL REQUIREMENTS

3.1.1 Hot Weather Installation

The following precautions shall be taken if masonry is erected when the ambient air temperature is more than 37 degrees C in the shade and the relative humidity is less than 50 percent. All masonry materials shall be shaded from direct sunlight; mortar beds shall be spread no more than 1.2 m ahead of masonry; masonry units shall be set within one minute of spreading mortar; and after erection, masonry shall be protected from direct exposure to wind and sun for 48 hours.

3.1.2 Cold Weather Installation

Before erecting masonry when ambient temperature or mean daily air temperature falls below 4 degrees C, a written statement of proposed cold weather construction procedures shall be submitted for approval. The following precautions shall be taken during all cold weather erection.

3.1.2.1 Preparation

Ice or snow formed on the masonry bed shall be thawed by the application of heat. Heat shall be applied carefully until the top surface of the masonry is dry to the touch. Sections of masonry deemed frozen and damaged shall be removed before continuing construction of those sections.

- a. Air Temperature 4 to 0 degrees C. Sand or mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C .
- b. Air Temperature 0 to minus 4 degrees C. Sand and mixing water shall be heated to produce mortar temperatures between 4 and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing.
- c. Air Temperature minus 4 to minus 7 degrees C (. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C. Temperature of mortar on boards shall be maintained above freezing. Sources of heat shall be used on both sides of walls under construction. Windbreaks shall be employed when wind is in excess of 24 km/hour.
- d. Air Temperature minus 7 degrees C and below. Sand and mixing water shall be heated to provide mortar temperatures between 4 and 49 degrees C . Enclosure and auxiliary heat shall be provided to maintain air temperature above 0 degrees C. Temperature of units when laid shall not be less than minus 7 degrees C.

3.1.2.2 Completed Masonry and Masonry Not Being Worked On

- a. Mean daily air temperature 4 to 0 degrees C. Masonry shall be protected from rain or snow for 24 hours by covering with weather-resistive membrane.

- b. Mean daily air temperature 0 to minus 4 degrees C. Masonry shall be completely covered with weather-resistant membrane for 24 hours.
- c. Mean Daily Air Temperature minus 4 to minus 7 degrees Masonry shall be completely covered with insulating blankets or equally protected for 24 hours.
- d. Mean Daily Temperature minus 7 degrees C and Below. Masonry temperature shall be maintained above 0 degrees C for 24 hours by enclosure and supplementary heat, by electric heating blankets, infrared heat lamps, or other approved methods.

3.2 LAYING MASONRY UNITS

Masonry units shall be laid in running bond pattern. Facing courses shall be level with back-up courses, unless the use of adjustable ties has been approved in which case the tolerances shall be plus or minus 13 mm (1/2 inch). Each unit shall be adjusted to its final position while mortar is still soft and plastic. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned, and relaid with fresh mortar. Air spaces, cavities, chases, expansion joints, and spaces to be grouted shall be kept free from mortar and other debris. Units used in exposed masonry surfaces shall be selected from those having the least amount of chipped edges or other imperfections detracting from the appearance of the finished work. Vertical joints shall be kept plumb. Units being laid and surfaces to receive units shall be free of water film and frost. Solid units shall be laid in a non-furrowed full bed of mortar. Mortar for veneer wythes shall be beveled and sloped toward the center of the wythe from the cavity side. Units shall be shoved into place so that the vertical joints are tight. Vertical joints of brick and the vertical face shells of concrete masonry units, except where indicated at control, expansion, and isolation joints, shall be completely filled with mortar. Mortar will be permitted to protrude up to 13 mm into the space or cells to be grouted. Means shall be provided to prevent mortar from dropping into the space below. In double wythe construction, the inner wythe may be brought up not more than 400 mm ahead of the outer wythe. Collar joints shall be filled with mortar or grout during the laying of the facing wythe, and filling shall not lag the laying of the facing wythe by more than 200 mm.

3.2.1 Surface Preparation

Surfaces upon which masonry is placed shall be cleaned of laitance, dust, dirt, oil, organic matter, or other foreign materials and shall be slightly roughened to provide a surface texture with a depth of at least 3. Sandblasting shall be used, if necessary, to remove laitance from pores and to expose the aggregate.

3.2.2 Forms and Shores

Forms and shores shall be sufficiently rigid to prevent deflections which may result in cracking or other damage to supported masonry and sufficiently tight to prevent leakage of mortar and grout. Supporting forms and shores shall not be removed in less than 10 days.

3.2.3 Concrete Masonry Units

Units in piers, pilasters, columns, starting courses on footings, solid foundation walls, lintels, and beams, and where cells are to be filled with grout shall be full bedded in mortar under both face shells and webs. Other units shall be full bedded under both face shells. Head

joints shall be filled solidly with mortar for a distance in from the face of the unit not less than the thickness of the face shell. Foundation walls below grade shall be grouted solid. Jamb units shall be of the shapes and sizes to conform with wall units. Solid units may be incorporated in the masonry work where necessary to fill out at corners, gable slopes, and elsewhere as approved. Double walls shall be stiffened at wall-mounted plumbing fixtures by use of strap anchors, two above each fixture and two below each fixture, located to avoid pipe runs, and extending from center to center of the double wall. Walls and partitions shall be adequately reinforced for support of wall-hung plumbing fixtures when chair carriers are not specified.

3.2.4 Clay or Shale Brick Units

Brick facing shall be laid with the better face exposed. Brick shall be laid in running bond with each course bonded at corners, unless otherwise indicated. Molded brick shall be laid with the frog side down. Brick that is cored, recessed, or has other deformations may be used in sills, treads, soldier courses, except where deformations will be exposed to view.

3.2.4.1 Wetting of Units

Wetting of clay, shale brick, or hollow brick units having an initial rate of absorption of more than 0.155 gm per minute per square cm of bed surface shall be in conformance with ASTM C 67. The method of wetting shall ensure that each unit is nearly saturated but surface dry when laid.

3.2.4.2 Solid Units

Bed, head, and collar joints shall be completely filled with mortar.

3.2.4.3 Hollow Units

Hollow units shall be laid as specified for concrete masonry units.

3.2.5 Tolerances

Masonry shall be laid plumb, true to line, with courses level. Bond pattern shall be kept plumb throughout. Corners shall be square unless noted otherwise. Except for walls constructed of prefaced concrete masonry units, masonry shall be laid within the following tolerances (plus or minus unless otherwise noted):

TABLE II TOLERANCES

Variation from the plumb in the lines and surfaces of columns, walls and arises

In adjacent masonry units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations from the plumb for external corners,
expansion joints, and other conspicuous lines

In 6 m	6 mm
In 12 m or more	13 mm

Variations from the level for exposed lintels,
sills, parapets, horizontal grooves, and other
conspicuous lines

In 6 m	6 mm
In 12 m or more	13 mm

Variation from level for bed joints and top
surfaces of bearing walls

In 3 m	6 mm
In 12 m or more	13 mm

Variations from horizontal lines

In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variations in cross sectional dimensions of
columns and in thickness of walls

Minus	6 mm
Plus	13 mm

3.2.6 Cutting and Fitting

Full units of the proper size shall be used wherever possible, in lieu of cut units. Cutting and fitting, including that required to accommodate the work of others, shall be done by masonry mechanics using power masonry saws. Concrete masonry units may be wet or dry cut. Wet cut units, before being placed in the work, shall be dried to the same surface-dry appearance as uncut units being laid in the wall. Cut edges shall be clean, true and sharp. Openings in the masonry shall be made carefully so that wall plates, cover plates or escutcheons required by the installation will completely conceal the openings and will have bottoms parallel with the masonry bed joints. Reinforced masonry lintels shall be provided above openings over 300 mm wide for pipes, ducts, cable trays, and other wall penetrations, unless steel sleeves are used.

3.2.7 Jointing

Joints shall be tooled when the mortar is thumbprint hard. Horizontal joints shall be tooled last. Joints shall be brushed to remove all loose and excess mortar. Mortar joints shall be finished as follows:

3.2.7.1 Flush Joints

Joints in concealed masonry surfaces and joints at electrical outlet boxes in wet areas shall be flush cut. Flush cut joints shall be made by cutting off the mortar flush with the face of the wall. Joints in unparged masonry walls below grade shall be pointed tight. Flush joints for architectural units, such as fluted units, shall completely fill both the head and bed joints.

3.2.7.2 Tooled Joints

Joints in exposed exterior and interior masonry surfaces shall be tooled slightly concave. Joints shall be tooled with a jointer slightly larger than the joint width so that complete contact is made along the edges of the unit. Tooling shall be performed so that the mortar is compressed and the joint surface is sealed. Jointer of sufficient length shall be used to obtain a straight and true mortar joint.

3.2.7.3 Door and Window Frame Joints

On the exposed interior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm. On the exterior side of exterior frames, joints between frames and abutting masonry walls shall be raked to a depth of 10 mm.

3.2.8 Joint Widths

Joint widths shall be as follows:

3.2.8.1 Concrete Masonry Units

Concrete masonry units shall have 10 mm joints.

3.2.8.2 Brick

Brick joint widths shall be the difference between the actual and nominal dimensions of the brick in either height or length. Brick expansion joint widths shall be as shown.

3.2.9 Embedded Items

Spaces around built-in items shall be filled with mortar. Openings around flush-mount electrical outlet boxes in wet locations shall be pointed with mortar. Anchors, ties, wall plugs, accessories, flashing, pipe sleeves and other items required to be built-in shall be embedded as the masonry work progresses. Anchors, ties and joint reinforcement shall be fully embedded in the mortar. Cells receiving anchor bolts and cells of the first course below bearing plates shall be filled with grout.

3.2.10 Unfinished Work

Unfinished work shall be stepped back for joining with new work. Toothing may be resorted to only when specifically approved. Loose mortar shall be removed and the exposed joints shall be thoroughly cleaned before laying new work.

3.2.11 Masonry Wall Intersections

Each course shall be masonry bonded at corners and elsewhere as shown. Masonry walls shall be anchored or tied together at corners and intersections with bond beam reinforcement and prefabricated corner or tee pieces of joint reinforcement as shown.

3.3 ANCHORED VENEER CONSTRUCTION

The inner and outer wythes shall be completely separated by a continuous airspace as shown on the drawings. Both the inner and the outer wythes shall be laid up together except when adjustable joint reinforcement assemblies are approved for use. When both wythes are not brought up together, through-wall flashings shall be protected from damage until they are fully enclosed in the wall. The airspace between the wythes shall be kept clear and free of mortar droppings by temporary wood strips laid on the wall ties and carefully lifted out before placing the next row of ties. A coarse gravel or drainage material shall be placed behind the weep holes in the cavity to a minimum depth of 100 mm of coarse aggregate or 250 mm of drainage material to keep mortar droppings from plugging the weep holes.

3.4 WEEP HOLES

Weep holes shall be provided not more than 600 mm on centers in mortar joints of the exterior wythe above wall flashing, over foundations, bond beams, and any other horizontal interruptions of the cavity. Weep holes shall be constructed using weep hole ventilators. Other approved methods may be used for providing weep holes. Weep holes shall be kept free of mortar and other obstructions.

3.5 COMPOSITE WALLS

Masonry wythes shall be tied together with joint reinforcement or with unit wall ties. Facing shall be anchored to concrete backing with wire dovetail anchors set in slots built in the face of the concrete as specified in SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. The facing wythe shall be anchored or tied to the backup at a maximum spacing of 400 mm on center vertically and 600 mm on center horizontally. Unit ties shall be spaced not over 600 mm on centers horizontally, in courses not over 400 mm apart vertically, staggered in alternate courses. Ties shall be laid not closer than 16 mm to either masonry face. Ties shall not extend through control joints. Collar joints between masonry facing and masonry backup shall be filled solidly with grout.

3.6 MORTAR

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes, but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume. Ingredients not in containers, such as sand, shall be accurately measured by the use of measuring boxes. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture which will adhere to the vertical surfaces of masonry units. Mortar that has

stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2-1/2 hours after mixing shall be discarded.

3.7 REINFORCING STEEL

Reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout, or other coating which might destroy or reduce its bond prior to placing grout. Bars with kinks or bends not shown on the drawings shall not be used. Reinforcement shall be placed prior to grouting. Unless otherwise indicated, vertical wall reinforcement shall extend to within 50 mm (of tops of walls.

3.7.1 Positioning Bars

Vertical bars shall be accurately placed within the cells at the positions indicated on the drawings. A minimum clearance of 13 mm shall be maintained between the bars and masonry units. Minimum clearance between parallel bars shall be one diameter of the reinforcement. Vertical reinforcing may be held in place using bar positioners located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement. Column and pilaster ties shall be wired in position around the vertical steel. Ties shall be in contact with the vertical reinforcement and shall not be placed in horizontal bed joints.

3.7.2 Splices

Bars shall be lapped a minimum of 48 diameters of the reinforcement. Welded or mechanical connections shall develop at least 125 percent of the specified yield strength of the reinforcement.

3.8 JOINT REINFORCEMENT

Joint reinforcement shall be installed at 400 mm on center or as indicated. Reinforcement shall be lapped not less than 150 mm. Prefabricated sections shall be installed at corners and wall intersections. The longitudinal wires of joint reinforcement shall be placed to provide not less than 16 mm cover to either face of the unit.

3.9 PLACING GROUT

Cells containing reinforcing bars shall be filled with grout. Hollow masonry units in walls or partitions supporting plumbing, heating, or other mechanical fixtures, voids at door and window jambs, and other indicated spaces shall be filled solid with grout. Cells under lintel bearings on each side of openings shall be filled solid with grout for full height of openings. Walls below grade, lintels, and bond beams shall be filled solid with grout. Units other than open end units may require grouting each course to preclude voids in the units. Grout not in place within 1-1/2 hours after water is first added to the batch shall be discarded. Sufficient time shall be allowed between grout lifts to preclude displacement or cracking of face shells of masonry units. If blowouts, flowouts, misalignment, or cracking of face shells should occur during construction, the wall shall be torn down and rebuilt.

3.9.1 Vertical Grout Barriers for Fully Grouted Walls

Grout barriers shall be provided not more than 10 m apart, or as required, to limit the horizontal flow of grout for each pour.

3.9.2 Horizontal Grout Barriers

Grout barriers shall be embedded in mortar below cells of hollow units receiving grout.

3.9.3 Grout Holes and Cleanouts

3.9.3.1 Grout Holes

Grouting holes shall be provided in slabs, spandrel beams, and other in-place overhead construction. Holes shall be located over vertical reinforcing bars or as required to facilitate grout fill in bond beams. Additional openings spaced not more than 400 mm on centers shall be provided where grouting of all hollow unit masonry is indicated. Openings shall not be less than 100 mm in diameter or 75 by 100 mm in horizontal dimensions. Upon completion of grouting operations, grouting holes shall be plugged and finished to match surrounding surfaces.

3.9.3.2 Cleanouts for Hollow Unit Masonry Construction

Cleanout holes shall be provided at the bottom of every pour in cores containing vertical reinforcement when the height of the grout pour exceeds 1.5 m. Where all cells are to be grouted, cleanout courses shall be constructed using bond beam units in an inverted position to permit cleaning of all cells. Cleanout holes shall be provided at a maximum spacing of 800 mm where all cells are to be filled with grout. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanouts shall not be less than 75 by 100 mm openings cut from one face shell. Manufacturer's standard cutout units may be used at the Contractor's option. Cleanout holes shall not be closed until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.3.3 Cleanouts for Solid Unit Masonry Construction

Cleanouts for construction of walls consisting of a grout filled cavity between solid masonry wythes shall be provided at the bottom of every pour by omitting every other masonry unit from one wythe. A new series of cleanouts shall be established if grouting operations are stopped for more than 4 hours. Cleanout holes shall not be plugged until masonry work, reinforcement, and final cleaning of the grout spaces have been completed and inspected. For walls which will be exposed to view, cleanout holes shall be closed in an approved manner to match surrounding masonry.

3.9.4 Grouting Equipment

3.9.4.1 Grout Pumps

Pumping through aluminum tubes will not be permitted. Pumps shall be operated to produce a continuous stream of grout without air pockets, segregation, or contamination. Upon

completion of each day's pumping, waste materials and debris shall be removed from the equipment, and disposed of outside the masonry.

3.9.4.2 Vibrators

Internal vibrators shall maintain a speed of not less than 5,000 impulses per minute when submerged in the grout. At least one spare vibrator shall be maintained at the site at all times. Vibrators shall be applied at uniformly spaced points not further apart than the visible effectiveness of the machine. Duration of vibration shall be limited to time necessary to produce satisfactory consolidation without causing segregation.

3.9.5 Grout Placement

Masonry shall be laid to the top of a pour before placing grout. Grout shall not be placed in two-wythe solid unit masonry cavity until mortar joints have set for at least 3 days during hot weather and 5 days during cold damp weather. Grout shall not be placed in hollow unit masonry until mortar joints have set for at least 24 hours. Grout shall be placed using a hand bucket, concrete hopper, or grout pump to completely fill the grout spaces without segregation of the aggregates. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. The height of grout pours and type of grout used shall be limited by the dimensions of grout spaces as indicated in Table III. Low-lift grout methods may be used on pours up to and including 1.5 m in height. High-lift grout methods shall be used on pours exceeding 1.5 m in height.

3.9.5.1 Low-Lift Method

Grout shall be placed at a rate that will not cause displacement of the masonry due to hydrostatic pressure of the grout. Mortar protruding more than 13 mm into the grout space shall be removed before beginning the grouting operation. Grout pours 300 mm or less in height shall be consolidated by mechanical vibration or by puddling. Grout pours over 300 mm in height shall be consolidated by mechanical vibration and reconsolidated by mechanical vibration after initial water loss and settlement has occurred. Vibrators shall not be inserted into lower pours that are in a semi-solidified state. Low-lift grout shall be used subject to the limitations of Table III.

3.9.5.2 High-Lift Method

Mortar droppings shall be cleaned from the bottom of the grout space and from reinforcing steel. Mortar protruding more than 6 mm into the grout space shall be removed by dislodging the projections with a rod or stick as the work progresses. Reinforcing, bolts, and embedded connections shall be rigidly held in position before grouting is started. CMU units shall not be pre-wetted. Grout, from the mixer to the point of deposit in the grout space shall be placed as rapidly as practical by pumping and placing methods which will prevent segregation of the mix and cause a minimum of grout splatter on reinforcing and masonry surfaces not being immediately encased in the grout lift. The individual lifts of grout shall be limited to 1.2 m in height. The first lift of grout shall be placed to a uniform height within the pour section and vibrated thoroughly to fill all voids. This first vibration shall follow immediately behind the pouring of the grout using an approved mechanical vibrator. After a waiting period sufficient to permit the grout to become plastic, but before it has taken any set, the succeeding lift shall be poured and vibrated 300 to 450 mm into the preceding lift. If the placing of the succeeding lift is going to be delayed beyond the period of workability of the preceding, each lift shall be

reconsolidated by reworking with a second vibrator as soon as the grout has taken its settlement shrinkage. The waiting, pouring, and reconsolidation steps shall be repeated until the top of the pour is reached. The top lift shall be reconsolidated after the required waiting period. The high-lift grouting of any section of wall between vertical grout barriers shall be completed to the top of a pour in one working day unless a new series of cleanout holes is established and the resulting horizontal construction joint cleaned. High-lift grout shall be used subject to the limitations in Table III.

TABLE III

POUR HEIGHT AND TYPE OF GROUT FOR VARIOUS GROUT SPACE DIMENSIONS

Maximum Grout Pour Height (m) (4)	Grout Type	Grouting Procedure	Minimum Dimensions of the Total Clear Areas Within Grout Spaces and Cells (mm) (1,2)	
			Multiwythe Masonry (3)	Hollow-unit Masonry
0.3	Fine	Low Lift	20	40 x 50
1.5	Fine	Low Lift	50	50 x 75
2.4	Fine	High Lift	50	50 x 75
3.6	Fine	High Lift	65	65 x 75
7.3	Fine	High Lift	75	75 x 75
0.3	Coarse	Low Lift	40	40 x 75
1.5	Coarse	Low Lift	50	65 x 75
2.4	Coarse	High Lift	50	75 x 75
3.6	Coarse	High Lift	65	75 x 75
7.3	Coarse	High Lift	75	75 x 100

3.10 BOND BEAMS

Bond beams shall be filled with grout and reinforced as indicated on the drawings. Grout barriers shall be installed under bond beam units to retain the grout as required. Reinforcement shall be continuous, including around corners, except through control joints or expansion joints, unless otherwise indicated on the drawings. Where splices are required for continuity, reinforcement shall be lapped 48 bar diameters. A minimum clearance of 13 mm shall be maintained between reinforcement and interior faces of units.

3.11 CONTROL JOINTS

Control joints shall be provided as indicated and shall be constructed by using special control-joint units in accordance with the details shown on the drawings. Sash jamb units shall have a 19 by 19 mm groove near the center at end of each unit. The vertical mortar joint at control joint locations shall be continuous, including through all bond beams. This shall be accomplished by utilizing half blocks in alternating courses on each side of the joint. The control joint key shall be interrupted in courses containing continuous bond beam steel. In single wythe exterior masonry walls, the exterior control joints shall be raked to a depth of 20 mm; backer rod and sealant shall be installed in accordance with SECTION: JOINT

SEALING. Exposed interior control joints shall be raked to a depth of 6 mm. Concealed control joints shall be flush cut.

3.12 BRICK EXPANSION JOINTS AND CONCRETE MASONRY VENEER JOINTS

Brick expansion joints and concrete masonry veneer joints shall be provided and constructed as shown on the drawings. Joints shall be kept free of mortar and other debris.

3.13 SHELF ANGLES

Shelf angles shall be adjusted as required to keep the masonry level and at the proper elevation. Shelf angles shall be galvanized. Shelf angles shall be provided in sections not longer than 3 m and installed with a 6 mm gap between sections. Shelf angles shall be mitered and welded at building corners with each angle not shorter than 1.2 m, unless limited by wall configuration.

3.14 LINTELS

3.14.1 Masonry Lintels

Masonry lintels shall be constructed with lintel units filled solid with grout in all courses and reinforced with a minimum of two No. 4 bars in the bottom course unless otherwise indicated on the drawings. Lintel reinforcement shall extend beyond each side of masonry opening 40 bar diameters or 600 mm, (24 inches,) whichever is greater. Reinforcing bars shall be supported in place prior to grouting and shall be located 13 mm above the bottom inside surface of the lintel unit.

3.14.2 Precast Concrete and Steel Lintels

Precast concrete and steel lintels shall be as shown on the drawings. Lintels shall be set in a full bed of mortar with faces plumb and true. Steel and precast lintels shall have a minimum bearing length of 200 mm unless otherwise indicated on the drawings.

3.15 SILLS AND COPINGS

Sills and copings shall be set in a full bed of mortar with faces plumb and true.

3.16 ANCHORAGE TO CONCRETE AND STRUCTURAL STEEL

3.16.1 Anchorage to Concrete

Anchorage of masonry to the face of concrete columns, beams, or walls shall be with dovetail anchors spaced not over 400 mm on centers vertically and 600 mm on center horizontally.

3.16.2 Anchorage to Structural Steel

Masonry shall be anchored to vertical structural steel framing with adjustable steel wire anchors spaced not over 400 mm on centers vertically, and if applicable, not over 600 mm on centers horizontally.

3.17 THROUGH WALL FLASHING

Continuous flashing shall be provided at the bottom of the wall cavity just above grade. Flashing shall also be provided above and below openings at lintels and sills, at shelf angles, other interruptions in the cavity and as indicated on the drawings. Flashing shall be as detailed and as specified in paragraph 2.12. Flashing shall be lapped a minimum of 150 mm at joints and shall be sealed with a mastic as recommended by the flashing manufacturer to prevent water running under flashing. Vertical leg of flashing shall be at least 200 mm. Ends of flashing at doors, windows, louvers, openings, lintels and shelf angles shall be turned up at least 25 mm at the next head joint and secured to form a barrier to the lateral flow of water within the wall. Height of flashing at base of air cavity shall be at least 150 mm taller than cavity drainage fabric. Flashing shall extend through the exterior face of the masonry veneer and shall be turned down to form a hemmed drip edge. Weeps shall be placed immediately above the flashing.

3.18 SPLASH BLOCKS

Splash blocks shall be located as shown.

3.19 POINTING AND CLEANING

After mortar joints have attained their initial set, but prior to hardening, mortar and grout daubs or splashings shall be completely removed from masonry-unit surfaces that will be exposed or painted. Before completion of the work, defects in joints of masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Immediately after grout work is completed, scum and stains which have percolated through the masonry work shall be removed using a high pressure stream of water and a stiff bristled brush. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened. Masonry surfaces shall be left clean, free of mortar daubs, dirt, stain, and discoloration, including scum from cleaning operations, and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

3.19.1 Concrete Masonry Unit and Concrete Brick Surfaces

Exposed concrete masonry unit and concrete brick surfaces shall be dry-brushed at the end of each day's work and after any required pointing, using stiff-fiber bristled brushes.

3.19.2 Clay or Shale Brick Surfaces

Exposed clay or shale brick masonry surfaces shall be cleaned as necessary to obtain surfaces free of stain, dirt, mortar and grout daubs, efflorescence, and discoloration or scum from cleaning operations. After cleaning, the sample panel of similar material shall be examined for discoloration or stain as a result of cleaning. If the sample panel is discolored or stained, the method of cleaning shall be changed to assure that the masonry surfaces in the structure will not be adversely affected. The exposed masonry surfaces shall be water-soaked and then cleaned with a solution proportioned 30 ml trisodium phosphate and 30 ml laundry detergent to 1 L of water or cleaned with a proprietary masonry cleaning agent specifically recommended for the color and texture by the clay products manufacturer. The solution shall be applied with stiff fiber brushes, followed immediately by thorough rinsing with clean water. Proprietary cleaning agents shall be used in conformance with the cleaning

product manufacturer's printed recommendations. Efflorescence shall be removed in conformance with the brick manufacturer's recommendations.

3.19.3 Prefaced Concrete Masonry Unit Surfaces

Prefaced concrete masonry unit surfaces shall be cleaned with soap powder and clean water applied with stiff fiber brushes. Excess mortar shall be removed with wood paddles. Metal cleaning tools, metal brushes, abrasive powders, and acid solutions shall not be used. At the completion of cleaning operations, the surfaces shall be rinsed with clean water. In areas of traffic within the building, a barricade of wood supported by framing lumber shall be erected to protect the units. In other areas, a heavy kraft-type building paper shall be taped over the units until final acceptance.

3.20 BEARING PLATES

Bearing plates for beams, joists, joist girders and similar structural members shall be set to the proper line and elevation with damp-pack bedding mortar, except where non-shrink grout is indicated. Bedding mortar and non-shrink grout shall be as specified in SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE.

3.21 APPLICATION OF LIQUID WATER REPELLANT

Liquid water repellant is required on Concrete Brick, Concrete Masonry and Brick Masonry surfaces exposed to the environment. Apply repellant after completion of adjoining elastomeric sealant work and initial cleaning of units. Apply material in accordance with manufacturer's printed instructions. Mask adjacent areas to avoid contamination of glass, EIFS and other adjacent surfaces. After 21 days, spray water on coated surfaces and recoat any absorptive surfaces.

3.22 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.23 TEST REPORTS

3.23.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.23.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

3.23.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Units meeting the definition of "effloresced" will be subject to rejection.

END OF SECTION

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SECTION 04220

NONBEARING MASONRY VENEER/STEEL STUD WALLS

PART 1 GENERAL

Nonbearing masonry veneer/steel stud wall systems for the Medium Company Operations Facility and the Large Battalion Headquarters require that design and calculations be performed by a Professional Engineer currently registered in the State of Washington.

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
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AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Manual	(1996) Cold-Formed Steel Design Manual
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 82	(1997a) Steel Wire, Plain, for Concrete Reinforcement
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 67	(1998a) Sampling and Testing Brick and Structural Clay Tile
ASTM C 79/C 79M	(1997) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 90	(1998) Load-Bearing Concrete Masonry Units
ASTM C 91	(1998) Masonry Cement

ASTM C 216	(1998) Facing Brick (Solid Masonry Units Made from Clay or Shale)
ASTM C 270	(1997a) Mortar for Unit Masonry
ASTM C 494	(1998) Chemical Admixtures for Concrete
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 744	(1998) Prefaced Concrete and Calcium Silicate Masonry Units
ASTM C 780	(1996) Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry
ASTM C 954	(1998) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
ASTM C 955	(1998) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM C 1002	(1998) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1072	(1998) Measurement of Masonry Flexural Bond Strength
ASTM C 1177/C 1177M	(1996) Glass Mat gypsum Substrate for Use as Sheathing
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1330	(1985; R 1995) Rubber Sheet Gaskets
ASTM D 1667	(1997) Flexible Cellular Materials - Vinyl Chlorine Polymers and Copolymers (Closed-Cell Foam)

ASTM D 2103 (1997) Polyethylene Film and Sheeting

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
(ASHRAE)

ASHRAE Hdbk-IP (1997) Handbook, Fundamentals I-P Edition

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3 (1998) Structural Welding Code - Sheet Steel

DEPARTMENT OF COMMERCE (DOC)

DOC PS 1 (1996) Voluntary Product Standard - Construction and
Industrial Plywood

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Masonry Veneer/Steel Stud Wall System; G

Design calculations demonstrating structural adequacy of cold formed steel framing to meet the strength and deflection criteria specified. Calculations demonstrating the structural adequacy of undesignated steel lintels and shelf angles for the calculated gravity loads being supported; this analysis shall be in accordance with AISC ASD Manual. Test results demonstrating that the veneer anchors are structurally adequate to resist the specified loadings shall be submitted for approval. Minimum out of plane wind loading shall be per ASCE 7-98 "Components and Cladding" seismic loading per TI-809-04.

Calculations demonstrating the insulation shown on the drawings provides the specified U-value for heat transmission of the completed exterior wall construction; this analysis shall be in accordance with ASHRAE Hdbk-IP. Manufacturer's descriptive data and installation instructions for the insulation, the vapor barrier and the moisture barrier.

SD-02 Shop Drawings

Detail Drawings; G

Details of cold-formed steel framing and support around openings, including framing connections, steel lintels, steel shelf angles, attachment to other building elements and bridging. Details of expansion joints and joints between brick and other materials. Drawings shall indicate thickness, material, dimensions, protective coatings, and section properties of all steel lintels and shelf angles used in exterior

wall framing. Drawings shall also indicate size and type of all fasteners including size and type of all welds. If the Contractor opts to furnish inch-pound (IP) masonry products, drawings showing elevation of walls exposed to view, with IP dimensions of vertical and horizontal construction and indicating the location of all masonry and pre-cast concrete products shall be submitted for approval.

SD-04 Samples

Expansion Joint Materials; G
Clay or Shale Brick; G
Concrete Masonry Unit; G
Prefaced Concrete Masonry Unit; G
Veneer Anchors and Fasteners; G
Brick Sample Panel; G

A portable panel, approximately 600 by 600 mm, containing random selected brick or CMU to establish the range of color and texture. Provide one of each type of masonry veneer anchor used. Also provide three samples of each type of special brick and CMU shape.

SD-07 Certificates

Clay or Shale Brick; G
Concrete Masonry Unit; G
Joint Reinforcement;
Expansion Joint Materials;
Insulation; G
Exterior Sheathing; G
Moisture Barrier;
Vapor Retarder;
Veneer Anchors; G
Welding; G

Certificates stating that the materials and welders meet the requirements specified. Each certificate shall be signed by an authorized certification official and shall include their organization and position and shall identify the products covered under their certifying signature.

1.3 SAMPLE PANEL

After the material samples are approved and prior to starting masonry work, at least two sample masonry panels, demonstrating the variations in exterior wall construction of the barracks and administrative buildings, shall be built on the project site where directed. The sample panels shall be not less than 1.8 m long by 1.2 m high. The panels shall be of typical wall thickness for the construction represented. The panels shall show color range, texture, bond pattern, expansion joints, and cleaning of the masonry as required in the work. One panel edge shall incorporate a window opening jamb with 300 mm deep segments of sill and head construction. The panel shall also show cold-formed steel framing, pre-cast concrete sills insulation, gypsum wallboard, gypsum sheathing, moisture barrier, vapor barrier, veneer anchors, joint reinforcement, steel shelf angles, flashing and weep holes. The approved sample panel shall be used as a standard of workmanship required in the actual installation.

The sample panel shall be protected from weather and construction operations and shall not be removed until the masonry veneer/steel stud wall work has been completed and accepted.

1.4 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered and handled avoiding chipping, breakage, bending or other damage, and contact with soil or other contaminating materials. The masonry products shall be stored off the ground and protected from inclement weather. Cementitious materials shall be delivered in unopened containers plainly marked and labeled with manufacturer's names and brands. Cementitious materials shall be stored in dry, weather-tight enclosures or covers. Sand and other aggregates shall be stored preventing contamination or segregation and under a weather-tight covering permitting good air circulation. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content galvanizing repair paint whenever necessary to prevent the formation of rust. Insulation, moisture barrier, and gypsum sheathing shall be stored in dry, well ventilated, weather-tight areas protected from sunlight and excessive heat. Air infiltration type vapor barrier shall be stored in accordance with the manufacturer's recommendations.

1.5 EFFLORESCENCE TESTS

1.5.1 Brick

Efflorescence tests shall be performed by an approved commercial testing laboratory. Sampling for the tests shall be the responsibility of the Contractor. Brick shall be sampled and tested for efflorescence in accordance with ASTM C 67 and the rating shall be: "not effloresced".

1.5.2 Mortar and Grout

A specimen of each proposed mix of mortar and grout, weighing approximately 3 ounces, shall be prepared using as little water as possible. While still in the plastic condition and prior to the initial set, each mortar and grout specimen shall be placed in a glass or glazed receptacle, and 4 ounces of distilled water shall be mixed with the specimen and stirred thoroughly for 5 minutes. The receptacle shall be of such a size that when the mortar and grout specimen and water are combined in solution, and a masonry unit is placed into it, the solution will have a depth of one half inch to 1 inch. A masonry unit, that has been tested and found free of efflorescence, shall be placed on end in the solution and the water level maintained at one half inch to 1 inch with distilled water. After continuous contact with the solution, indoors at a temperature range of 75 degrees F, plus or minus 15 degrees for 7 days, the masonry unit shall be removed from the solution and air-dried for 24 hours. The masonry unit shall be compared with an untreated unit and if the difference due to efflorescence is noticeable when viewed at a distance of 10 feet, the components of the mortar and grout mixes shall be tested independently. Cementitious components shall be prepared for testing by thoroughly mixing 1 ounce of the cementitious material with 4 ounces of distilled water. Aggregate components shall be prepared for testing by thoroughly mixing 3 ounces of the aggregate component with 4 ounces of distilled water. Each mixture shall be tested as specified above for the proposed mix. The component causing efflorescence shall be rejected. Testing cycle shall be repeated with new component(s) until successful.

1.6 PROJECT CONDITIONS

Verify location of all construction adjacent to and penetrating exterior wall construction by field measurement prior to fabrication. Final shop drawings shall indicate field measurements. Coordinate work of related trades to ensure proper location of cast-in-place components and structural members.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of exterior brick veneer wall construction with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Brick and concrete masonry units meet all requirements for shape, size, strength, etc.
- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Sample panels are built and provided with all features of the wall construction as indicated.
- (6) Masonry installation is coordinated with interfacing construction to eliminate conflicts.
- (7) Masonry sealing operations have been reviewed and approved by a technical representative of the sealer manufacturer.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 VENEER WYTHE

The source of masonry materials which will affect the appearance of the finished work shall not be changed after the work has started except with the Contracting Officer's approval. The Contractor has the option to use either hard metric or substitute inch-pound (soft-metric) masonry products. If the Contractor decides to substitute inch-pound masonry products, the following additional requirements shall be met:

- a. The dimensions indicated on the drawings shall not be altered to accommodate inch-pound masonry products either horizontally or vertically. The 100 mm building module shall be maintained, except for the actual physical size of the masonry products themselves.
- b. Mortar joint widths shall be maintained as specified.

- c. Indicated reinforcing bar spacing shall not be exceeded. Inch-pound masonry products shall accommodate reinforcing bar placement. Reinforcing bars shall not be cut, bent or eliminated to fit into the inch-pound masonry product modules.
- d. Masonry inch-pound products shall not be reduced in size by more than one-third ($1/3$) in height and one-half ($1/2$) in length. Masonry products shall not be cut at ends of walls, corners, and other openings.
- e. Cut, exposed masonry products shall be held to a minimum and shall be located where they will have the least impact on the aesthetics of the facility.
- f. Other building components built into the masonry products, such as window frames, door frames, louvers, fire dampers, etc., that are required to be metric, shall remain metric.
- g. Additional metric guidance shall conform to Section 01415 METRIC MEASUREMENTS.

2.1.1 Clay or Shale Brick

Clay or shale brick veneer shall be new masonry units conforming to ASTM C 216, Type FBS. Color range and texture shall be as indicated and shall conform to the approved sample. Grade SW shall be used for all brick units. Brick unit sizes shall be Modular (92 x 57 x 194) at Company and Battalion buildings and Utility (92 x 92 x 295) at Barracks. Brick used on Dumpster Enclosures shall match the building served. Colors shall be as shown on exterior finish schedules..

2.1.2 Concrete Masonry Unit

Concrete masonry unit veneer shall be solid and conform to ASTM C 90, Type I. Architectural type, color range and texture shall be as indicated and shall conform to the approved sample. Masonry unit sizes shall be as shown.

2.1.3 Prefaced Concrete Masonry Unit

Prefaced concrete masonry unit veneer shall conform to ASTM C 744 using masonry units conforming to ASTM C 90 Type I. Prefaced concrete unit facing shall turn over the edges and ends of the unit at least 10 mm in the direction of the thickness of the unit to form a lip at least 2 mm thick. Variation in color and texture shall not exceed that of the approved samples. Masonry unit sizes shall be as shown.

2.2 MORTAR

Mortar shall conform to ASTM C 270, Type S. Mortar mix shall be based on a laboratory tested mix using proportion specifications. Laboratory testing of mortar shall be in accordance with the preconstruction evaluation of mortar section of ASTM C 780. Cement shall have a low alkali content and be of one brand. Aggregates shall be from one source. Mortar mix shall develop a minimum laboratory compressive strength of 14 MPa at 28 days.

2.2.1 Masonry Cement

Masonry cement in conformance with ASTM C 91 and with a free alkali content of less than 0.1 percent, may be used in the mortar. When using a masonry cement a comparative test shall be performed between a Portland cement-lime mortar and the masonry cement mortar proposed for the project to evaluate the ASTM C 1072 bond and the ASTM C 780 compressive strength of the two mixes. The test shall be conducted with the proposed masonry units for the project. The masonry cement mortar will be acceptable if the bond and compressive strength values are equal to or higher than the portland cement-lime mix. The air-content of the masonry cement shall be limited to 12 percent maximum.

2.2.2 Admixtures

In cold weather, a non-chloride based accelerating admixture may be used subject to approval. Accelerating admixtures shall be non-corrosive, contain less than 0.2 percent chlorides, and conform to ASTM C 494, Type C.

2.3 HORIZONTAL JOINT REINFORCEMENT

Horizontal joint reinforcement shall be of steel wire conforming to ASTM A 82. Fabrication shall be by welding. Tack welding will not be permitted. Reinforcement shall be zinc-coated after fabrication in accordance with ASTM A 153/A 153M, Class B-2. Joint reinforcement shall consist of at least 1 continuous longitudinal wire in the veneer wythe. Minimum wire cross section shall be 11 square mm (0.017 square inches). Minimum mortar cover shall be 16 mm. Joint reinforcement shall be placed in all horizontal mortar joints to receive anchor ties. Reinforcement shall be continuous with lap splices between ties.

2.4 COLD-FORMED STEEL FRAMING

Cold-formed framing shall consist of steel studs, top and bottom tracks, runners, horizontal bridging, and other cold-formed members and other accessories. All members and components made of sheet steel shall be hot-dip galvanized in accordance with ASTM A 653/A 653M with a minimum coating thickness of G 90. The steel studs and other cold-formed steel framing members within the wall shall be designed to resist the entire wind and seismic loadings acting inward and outward perpendicular to the wall system without exceeding a deflection of 1/720 times the vertical stud span and AISI-01 allowable stresses. To prevent the masonry wythe from cracking due to "hard spot" support at doors, windows, and other openings, the completed design of the cold-formed steel system shall result in bending stiffness and deflections at openings that are compatible with those away from wall openings. Design calculations shall be submitted for approval. Framing covered herein shall be used only in framing the exterior masonry veneer steel stud wall system as indicated on the detail drawings. Metal framing for interior partitions are specified in Section GYPSUM WALLBOARD. Metal framing for other applications is specified in Section COLD-FORMED METAL FRAMING.

2.4.1 Steel Studs

Studs at exterior brick veneer walls shall be minimum (1.2 mm) 18 gauge steel conforming to ASTM A 653/A 653M with minimum yield strength of 230 MPa. Studs shall be 150 mm deep with a minimum flange width of 40 mm and return lip of 14 mm. Studs where special reinforcement is required, as indicated on drawings, shall be 14 gauge with a minimum yield strength of 345 MPa. Studs of 14 gauge or heavier may be shop welded. Shop welds for

studs shall be thoroughly cleaned and painted with a zinc-rich paint before shipment to the construction site. Section properties of all studs shall be determined in accordance with the AISI specifications for Design of Cold-Formed Steel Structural Members. .

2.4.2 Runners, Tracks, Bridging and Accessories

Cold-formed steel sheet framing members, components, and accessories required to complete the wall, other than the steel studs, shall conform to ASTM C 955 and be of steel conforming to ASTM A 653/A 653M, Grade 33, having a minimum yield strength of 230 MPa.

2.5 INSULATION

2.5.1 Blanket Insulation (COF and BTN Buildings)

Insulation placed between the steel studs shall be batt or blanket type mineral wool conforming to ASTM C 665, Type I. Insulation shall be Class A (flamespread of 25 or less) and be rated "R-19".

2.5.2 Polyisocyanurate Spray Insulation (Barracks and SCB)

Insulation sprayed into stud walls shall be as specified in Section: BUILDING INSULATION.

2.5.3 Rigid Cavity Insulation

Insulation installed in drainage cavity between sheathing and veneer brick shall be polystyrene board as specified in Section: BUILDING INSULATION.

2.6 GYPSUM WALLBOARD

Gypsum wallboard that is installed on the interior side of the cold-formed steel framing system shall be as specified in Section: GYPSUM WALLBOARD.

2.7 EXTERIOR SHEATHING

Gypsum sheathing that is installed on the exterior side of the cold-formed steel framing system shall be exterior grade, glass mat type, have a minimum thickness of 16 mm and shall be 1.2 m wide. Glass mat gypsum sheathing shall conform to ASTM C 79/C 79M and ASTM C 1177/C 1177M. Glass mat gypsum sheathing shall have a water-resistant core with a water-resistant glass mat embedded onto core and shall have a zero flame with zero smoke developed rating, and shall have mold and mildew resistant surface.

2.8 MOISTURE PROTECTION

2.8.1 Moisture Barrier

The moisture barrier shall be 6.7 kg asphalt-saturated felt conforming to ASTM D 226 Type I (No. 15).

2.8.2 Vapor Retarder

The vapor retarder shall be polyethylene film conforming to ASTM D 2103, 0.15 mm (6 mil) 6 mil minimum thickness. Vapor retarder shall have a perm rating of 1 or less.

2.8.3 Staples

Staples for attaching the moisture barrier to the exterior sheathing shall be the type and size best suited to provide a secure connection. Staples shall be made from either galvanized steel or stainless steel wire.

2.8.4 Joint Tape

Tape for sealing the joints in the vapor retarder shall be laminated tape with pressure sensitive adhesive as recommended by the manufacturer of the polyethylene film.

2.9 VENEER ANCHORS

Anchor assemblies for the attachment of the masonry veneer to the cold-formed steel framing, structural steel and concrete floor slabs shall be for the design loadings and performance criteria specified. Anchors shall transfer the design loadings from the masonry veneer to the cold-formed steel framing system or other support without exceeding the allowable stresses and deflections in the anchors in both tension and compression. Anchors shall be designed as seismic assemblies, adjustable and intended for use with steel studs. Corrugated and pintle-eye type anchors are not acceptable. Anchor plate with stiffening gussets shall be a minimum of 14 gauge and shall have two screws as anchorage to studs. Length of anchor wires shall be such that the outermost wires lie at or exterior to the centerline of the mortar bed and not closer than 30 mm from the exterior face of the masonry veneer. Ties shall incorporate a device for mechanical connection to positively engage the horizontal joint reinforcement. Anchors wires shall not have drips. Wires for veneer anchors shall be rectangular or triangular hoops formed from 5 mm diameter steel wire conforming to ASTM A 82. Anchor assemblies including wires and anchor plates shall be hot-dip galvanized conforming to ASTM A 153/A 153M, Class B-2. The veneer anchor shall have a minimum capacity of 900 newtons. The load-displacement capacity of each veneer anchor, both in direct pull-out for tension and compression, shall be not less than 350 kilo newtons per meter (2000 pounds per inch) (or a deflection of 2.85 mm per kilo newton (0.05 inches per 100 pounds) of load in tension or compression). In the direction perpendicular to the masonry veneer, the anchor assembly shall have a maximum play of 1.6 mm.

2.9.2 Dovetail Anchors

Dovetail slots are specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

2.10 CONNECTIONS

Screws, bolts and anchors shall be hot-dip galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate, or stainless steel.

2.10.1 Framing Screws, Bolts and Anchors

Screws, bolts and anchors used in the assembly of the cold-formed steel framing system shall be as required by design of the framing system for the specified loading. Screw, bolt and anchor sizes shall be shown on the detail shop drawings.

2.10.2 Welding

Welded connections shall be designed and all welding shall be performed in accordance with AWS D1.3, as modified by AISI Cold-Formed Manual. Welders shall be qualified in accordance with AWS D1.3. All welds shall be cleaned and touched-up with zinc-rich paint. Welders shall take appropriate ventilation measures when welding galvanized metals.

2.10.3 Veneer Anchor Screws

Screws for attachment of the veneer anchors to the cold-formed steel framing members shall be as required by design to provide the needed pullout load capacity but not less than No. 10. Screws shall be shown on the detail shop drawings. Each screw shall have a minimum ultimate pullout capacity of 540 pounds in 18 gauge material. Screws shall be hot-dipped galvanized in accordance with ASTM A153. The length of screws shall be such that the screws penetrate the holding member by not less than 16 mm.

2.10.4 Gypsum Sheathing Screws

Screws for attachment of gypsum sheathing to cold-formed steel framing shall conform to ASTM C 1002, Type S.

2.11 SYNTHETIC RUBBER WASHERS

Synthetic rubber washers for placement between veneer anchors and the moisture barrier on the outside face of the exterior sheathing shall conform to ASTM D 1330, Grade I.

2.12 CONTROL JOINT MATERIALS

Control joint materials shall be as indicated in Section JOINT SEALING.

2.13 EXPANSION JOINT KEYS

Expansion joint keys shall be factory fabricated solid section of natural or synthetic rubber or a combination thereof conforming to ASTM D2000, or polyvinyl chloride conforming to ASTM D2287. The material shall be resistant to oils and solvents and shall have a durometer hardness of 65 to 75. Keys shall be of the width and shape indicated and shall be designed to be used with standard concrete masonry sash units. Shear section shall be 16 mm minimum thickness.

2.14 FLASHING

Flashing material shall be copper or stainless steel sheet. Copper meeting ASTM B370, minimum 450 g (16 ounce) weight. Stainless steel meeting ASTM 167, Type 304, minimum 0.4 mm (0.016 inch) thickness. Provide with factory fabricated deformations that mechanically bond flashing against horizontal movement in all directions. Deformations shall

consist of dimples, diagonal corrugations, or a combination of dimples and transverse corrugations. Flashing installation practices shall conform to detailing contained on drawings and as specified in this section and SECTION: SHEET METALWORK, GENERAL. Flashing shall be supplied in a continuous sheet extending from the exterior sheathing across the cavity and through the masonry veneer as shown.

2.15 STEEL LINTELS AND SHELF ANGLES

Steel shapes used for undesignated lintels and shelf angles shall conform to ASTM A 36M. Lintels and shelf angles shall be provided at all openings shown, except where support is explicitly provided on the drawings. These steel members shall be hot-dip galvanized in accordance with ASTM A 123M. Lintel angles supported by and in the plane of the masonry veneer shall be as designed by the veneer wall manufacturer but not less than L127X76X9.5LLV for openings 1220 mm and less or L152X89X9.5LLV for openings between 1220 mm to 2440 mm.

2.16 CAULKING AND SEALANTS

Caulking and sealants shall be as specified in SECTION: JOINT SEALING.

2.17 CAVITY DRAINAGE FABRIC

Manufacturer's standard fabric product designed to ensure drainage from the cavity in brick veneer construction. Thickness to match cavity depth with minimum height of 200 mm. Fabricated of high density polyethylene (HDPE) or polyester mesh with at least 85 percent open weave construction. Materials shall be non-reactive with all adjacent materials found in air cavity. Design of fabric shall capture and suspend fallen mortar to maintain a path for air and water movement through and out of the cavity.

2.18 LIQUID WATER REPELLANT COATING

Water repellant shall be a clear penetrating coating that reacts with masonry surfaces to form a chemical water repellent bond; water based alkylalkoxysilane (20 percent by weight, minimum); applied in the field by an applicator approved in writing by the material manufacturer in accordance with the manufacturer's directions. Coating shall have a water absorption rate of not more than 0.53 percent in 48 hours when tested in accordance with ASTM C642-82. Coating shall not inhibit adhesion of sealants specified in SECTION: JOINT SEALING.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Wall sections, types of construction and dimensions shall be as shown. Metal door and window frames and other special framing shall be built and anchored into the wall system as indicated.

3.2 STEEL STUD WALL FRAMING

The top of the stud wall system shall be slip jointed with a double track system or vertical slide clips to accommodate vertical deflections of the supporting members as shown on the

shop drawings. Top and bottom tracks shall be securely anchored to resist track rotation by alternating fastener locations to provide two rows, one row near each track flange as shown on the drawings. Both flanges of all steel studs shall be securely fastened with screws to the flanges of the top and bottom tracks as shown on the drawings. All details for affixing steel studs to runners and all other sheet steel framing members along with all details necessary for anchorage of the steel stud wall system to the building structural systems shall be as shown on the shop drawings. Horizontal bridging shall be provided as necessary. Studs shall be spaced 400 mm on center. Coordinate stud spacing with sheathing and anchor requirements. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs as a minimum shall be provided at both jambs of all door, window and louver openings. Coordinate with performance criteria specified. Door frames and other built-in items shall be grouted solid.

3.3 STEEL SHELF ANGLES AND LINTELS

Unless otherwise shown, steel shelf angles and lintels shall be provided in segments that do not exceed 3.0 m in length. At building corners, shelf angle segments shall be mitered and securely attached together by welding with legs no less than 1.2 m where possible. Shelf angle segments shall not be connected together but instead shall be installed with 10 mm wide gaps between the segments. Fabrication and erection tolerances shall be in accordance with the AISC Code of Standard Practice, as indicated in AISC ASD Manual. Paint exposed areas of shelf angles and lintels as indicated in SECTION: PAINTING. Colors shall be as indicated on exterior finish schedules. Lintels in the plane of the veneer shall extend 200 mm beyond the edge of the opening unless otherwise indicated.

3.4 BATT INSULATION

The actual installed thickness of insulation shall provide a minimum thermal R of 19 for the insulation alone. Installation, except as otherwise specified or shown, shall be in accordance with the manufacturer's instructions which shall be approved by the Contracting Officer. Insulation shall be installed between wall framing members. Insulation shall be slightly compressed to the sides of the framing members to provide a continuous contact area such that the insulation will hold its position. Where electrical outlets, ducts, pipes, vents or other utility items occur, insulation shall be placed on the dry side of the item away from excessive humidity. Infill void areas in the plane of the wall, such as the webs of structural steel columns and beams, to provide a continuous R value matching that of stud wall areas.

3.5 GYPSUM WALLBOARD

Gypsum wallboard shall be installed on the interior face of the cold-formed steel framing system. Installation shall be as specified in SECTION: GYPSUM WALLBOARD. At vertical slip joints, the gypsum wallboard shall be connected to the vertical studs to prevent movement at the slip joint.

3.6 EXTERIOR SHEATHING

Sheathing shall be installed on the exterior face of the cold-formed steel framing system with self-drilling screws. Screws shall be located a minimum of 10 mm from the ends and edges of sheathing panels and shall be spaced not more than 200 mm on each supporting member

except at vertical slip joints, the sheathing shall be connected to the vertical studs to prevent movement of the slip joint. Edges and ends of gypsum sheathing panels shall be butted snugly with vertical joints staggered to provide full and even support for the moisture barrier. Holes and gaps resulting from abandoned screw installations, from damage to panels, and from cutting and fitting of panels at junctures with doors, windows, foundation walls, floor slabs and other similar locations shall be filled with exterior rubber-base caulk.

3.7 MOISTURE PROTECTION

3.7.1 Moisture Barrier

The asphalt-saturated felt or other approved moisture barrier shall be installed on the outer face of the exterior sheathing. The moisture barrier shall be installed horizontally and shingled with each sheet lapped not less than 150 mm over the sheet below. Vertical end joints shall be lapped not less than 150 mm and shall be staggered. Attachment of the moisture barrier shall be with staples spaced not greater than 400 mm on center or as required by the manufacturer.

3.7.2 Vapor Retarder

A vapor retarder shall be installed between the steel studs and the gypsum wall board. The vapor retarder shall be installed in accordance with the manufacturer's recommendations to form a complete retarder to vapor infiltration. The joints shall be lapped and sealed with tape. All wall penetrations such as doors, windows and electrical outlet and switch boxes shall have the vapor retarder edge tape sealed. All openings out of boxes into the wall shall also be sealed to provide an uninterrupted barrier. Vapor retarder shall extend uninterrupted from deck to deck, do not stop at ceiling plane.

3.8 VENEER ANCHORS

Veneer anchors shall be attached with screws through the sheathing to the steel studs or other support members at the locations shown. Attachment to sheathing alone is not acceptable. Veneer anchors shall be installed with the outermost wires aligned with the veneer as indicated in PARAGRAPH: 2.9 VENEER ANCHORS. Anchors shall be mechanically attached to horizontal joint reinforcement. Synthetic rubber washers shall be used between the anchor connector plates and the moisture barrier. A clutch torque slip screw gun shall be used on screws attaching veneer anchors to cold-formed steel members. Veneer anchors with corrugated sheet metal or wire mesh members extending across the wall cavity shall not be used. Pintle-eye anchors shall not be used. There shall be at least one veneer anchor for each 0.2 square meters of wall and shall be attached to steel studs and other supports with a maximum spacing of 400 mm on center horizontally. At all openings install additional ties at no greater than 1 000 mm on center within 300 mm of the opening. Dovetail slots shall be installed as specified in the SECTION: 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.9 THROUGH WALL FLASHING

Continuous flashing shall be provided at the bottom of the wall cavity just above grade. Flashing shall also be provided above and below openings at lintels and sills, at shelf angles, other interruptions in the cavity and as indicated on the drawings. Flashing shall be as detailed and as specified in SECTION: SHEET METALWORK, GENERAL. Flashing shall be

lapped a minimum of 150 mm at joints and shall be sealed with a mastic as recommended by the flashing manufacturer to prevent water running under flashing. Vertical leg of flashing shall be at least 200 mm. Ends of flashing at doors, windows, openings and shelf angles shall be turned up at least 25 mm at the next head joint and secured to form a barrier to the lateral flow of water within the wall. Height of flashing at base of air cavity shall be at least 150 mm taller than cavity drainage fabric. Flashing shall be lapped under the moisture barrier a minimum of 150 mm and securely attached to the gypsum sheathing. Flashing shall extend through the exterior face of the masonry veneer and shall be turned down to form a hemmed drip edge. Weeps shall be placed immediate above the flashing.

3.10 MASONRY VENEER

Exterior masonry wythes shall be constructed to the thickness indicated on the drawings. A cavity consisting of a nominal 50 mm width air space will be provided between the moisture barrier and the masonry veneer. Masonry veneer shall not be installed until the exterior sheathing, moisture barrier, veneer anchors and flashing have been installed on the cold-formed steel framing system. Extreme care shall be taken to avoid damage to the moisture barrier and flashing during construction of the masonry veneer. Any portion of the moisture barrier and flashing that is damaged shall be repaired or replaced prior to completion of the veneer. Masonry shall be placed in running bond pattern. Longitudinal reinforcement consisting of at least one continuous galvanized steel wire shall be placed in the veneer wythe. The minimum wire size shall be 9 gauge. Vertical joints on alternating courses shall be aligned and kept vertically plumb.

3.10.1 Surface Preparation

Surfaces on which masonry is to be laid shall be cleaned of laitance or other foreign material. Surfaces on which masonry is to be laid shall be inspected for compliance to tolerance dimensions specified herein. Verification shall be made that items required by other sections are properly located and sized. No units having a film of water or frost shall be laid.

3.10.2 Hot Weather Construction

Temperatures of masonry units and mortar shall not be greater than 50 degrees C (120 degrees F) when laid. Masonry erected when the ambient air temperature is more than 37 degrees C (99 degrees F) in the shade and when the relative humidity is less than 50 percent shall be given protection from the direct exposure to wind and sun for 48 hours after the installation.

3.10.3 Cold Weather Construction

Temperatures of masonry units and mortar shall not be less than 4 degrees C (40 degrees F) when laid. When the ambient air temperature is 0 degrees C (32 degrees F) or less, masonry veneer under construction shall be protected and maintained at a temperature greater than 0 degrees C (32 degrees F) for a period of 48 hours after installation. The proposed method of maintaining the temperature within the specified range shall be submitted for approval prior to implementation. No units shall be laid on a surface having a film of frost or water.

3.10.4 Tolerances

Masonry shall be laid plumb, level and true to line within the tolerances specified in TABLE 1. All masonry corners shall be square unless otherwise indicated on the drawings.

TABLE 1

Variation From Plumb

In adjacent units	3 mm
In 3 m	6 mm
In 6 m	10 mm
In 12 m or more	13 mm

Variation From Level Or Grades

In 3 m	3 mm
In 6 m	6 mm
In 12 m or more	13 mm

Variation From Linear Building Lines

In 6 m	13 mm
In 12 m or more	19 mm

Variation From Cross Sectional Dimensions Of Walls

Plus	13 mm
Minus	6 mm

3.10.5 Mixing of Mortar

Mortar shall be mixed in a mechanically operated mortar mixer for at least 3 minutes but not more than 5 minutes. Measurement of ingredients for mortar shall be by volume.

Measurement of sand shall be accomplished by the use of a container of known capacity or shovel count based on a container of known capacity. Water shall be mixed with the dry ingredients in sufficient amount to provide a workable mixture that will adhere to the vertical surfaces of the masonry units. Mortar that has stiffened because of loss of water through evaporation shall be retempered by adding water to restore the proper consistency and workability. Mortar that has reached its initial set or that has not been used within 2 hours shall be discarded.

3.10.6 Cutting and Fitting

Wherever possible, full units shall be used in lieu of cut units. Where cut units are required to accommodate the design, cutting shall be done by masonry mechanics using power masonry saws. Wet-cut units shall be dried to the same surface-dry appearances of uncut units before

being placed in the work. Cut edges shall be clean, true and sharp. Openings to accommodate pipes, conduits, and other accessories shall be neatly formed so that framing or escutcheons required will completely conceal the cut edges. Insofar as practicable, all cutting and fitting shall be accomplished while masonry work is being erected.

3.10.7 Masonry Units

When being laid, masonry units shall have suction sufficient to hold the mortar and to absorb water from the mortar, but shall be damp enough to allow the mortar to remain in a plastic state to permit the unit to be leveled and plumbed immediately after being laid without destroying bond. Masonry units with frogging shall be laid with the frog side down and the better or face side exposed to view. Masonry units that are cored, recessed or otherwise deformed may be used in sills or in other areas except where deformations will be exposed to view. Masonry units with an initial absorption rate of more than 0.025 ounces per minute per square inch of bed surface as determined by ASTM C 67, shall be wetted. The method of wetting shall insure that each unit is nearly saturated but surface dry when laid, unless otherwise recommended by the brick manufacturer. Placing masonry units that are chipped, scored, broken, stained or otherwise damaged will not be allowed. The specified masonry unit types shall be placed as follows:

- a. Modular brick field: Place in a running bond pattern.
- b. Utility brick field: Place in a running bond pattern with a 1/3 overlap to maintain a 100 mm module.
- c. Corners/sills/corbels/headers/trim: Place as indicated.

3.10.8 Mortar Joints

Mortar joint widths shall be uniform and such that the specified widths are maintained throughout. Joints shall be of thickness equal to the difference between the actual and nominal dimensions of the masonry units in either height or length but in no case shall the joints be less than 6 mm nor more than 13 mm wide. Joints shall be tooled slightly concave. Tooling shall be accomplished when mortar is thumbprint hard and in a manner that will compress and seal the mortar joint and produce joints of straight and true lines free of tool marks. Joints indicated to be caulked shall be raked to a depth of 20 mm.

3.10.9 Placing Mortar

Solid masonry units shall be laid in a non-furrowed full bed of mortar, beveled and sloped toward the center of the wythe on which the mortar is placed. Units shall be shoved into place so that the vertical mortar joints are completely full and tight. Units that have been disturbed after the mortar has stiffened shall be removed, cleaned and relaid. Mortar which protrudes more than 13 mm into the cavity space shall be removed. Means shall be provided to ensure that the cavity space is kept clean of mortar droppings and other loose debris. Chases and raked-out joints shall be kept free from mortar and debris. Faces of units used in finished exposed areas shall be free from chipped edges, material texture or color defects or other imperfections distracting from the appearance of the finished work.

3.10.10 Joint Reinforcement

Unless otherwise shown, joint reinforcement shall be spaced at 400 mm on center vertically. Joint reinforcement shall be placed in the same masonry course as veneer anchors with the anchors mechanically fastened to the wire. Joint reinforcement shall be placed so that longitudinal wires are centered in the veneer wythe for solid units. Longitudinal wires shall be fully embedded in mortar for their entire length. Splices in joint reinforcement shall be lapped a minimum of 150 mm. Joint reinforcement must be discontinuous at all veneer joints. The minimum cover for joint reinforcement is 30 mm.

3.10.11 Veneer Joints

Brick expansion and control joints, concrete masonry veneer joints and miscellaneous perimeter joints at doors, windows, louvers and other openings shall be provided at the locations shown on the drawings. In general, joints shall be 6 mm to 13 mm wide and at least 6 mm deep. Details of joints shall be as indicated on the drawings. Joints shall be clean and free of mortar and shall contain only pre-mold control joint material, backer rod and sealant, installed in accordance with SECTION: JOINT SEALING. Horizontal reinforcement shall not extend through the joints.

3.10.12 Weep Holes

Weep holes shall be provided at all through wall flashing locations at intervals of 600 mm. Weep holes shall be placed in head joints just above the flashing. Weep holes shall be formed with open head joints with plastic cellular screens to restrict insect access. Weep holes shall be kept free of mortar and other obstructions.

3.10.13 Head Joint Vents

Head joint vents shall be provided near the top of the veneer wythe at the same spacing as the weep holes.

3.10.14 Discontinuous Work

When necessary to temporarily discontinue the work, masonry shall be stepped back for joining when work resumes. Tothing may be used only when specifically approved. Before resuming work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned. Top of walls subjected to rain or snow shall be covered with non-staining waterproof covering or membrane when work is not in process. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place.

3.10.15 Cleaning

Mortar daubs or splashings shall be completely removed from finished exposed masonry surfaces before they harden or set up. Before completion of the work, defects in mortar joints shall be raked out as necessary, filled with mortar, and tooled to match the adjacent existing mortar in the joints. The proposed cleaning method shall be done on the sample wall panel and the sample panel shall be examined for discoloration or stain. If the sample panel is discolored or stained, the method of cleaning shall be changed to ensure that the masonry surfaces in the structure will not be adversely affected. Masonry surfaces shall not be cleaned, other than removing excess surface mortar, until mortar in joints has hardened.

Cleaning shall be accomplished with the use of stiff bristle fiber brushes, wooden paddles, wooden scrapers, or other suitable nonmetallic tools. The exposed brick surfaces shall be saturated with water and cleaned with a proprietary brick cleaning agent recommended by the clay products manufacturer. The cleaning agent shall not adversely affect the brick masonry surfaces. Proprietary cleaning agents shall be used in conformance with the cleaning product manufacturer's printed recommendations. Concrete masonry unit surfaces shall be dry-brushed at the end of each day's work after any required pointing has been done. Efflorescence or other stains shall be removed in conformance with the recommendations of the masonry unit manufacturer. After construction and cleaning, masonry surfaces shall be left clean, free of mortar daubs, stain, and discolorations, including scum from cleaning operations, and will have tight mortar joints throughout. Metallic tools and brushes shall not be used for cleaning.

3.11 APPLICATION OF LIQUID WATER REPELLANT

Liquid water repellant is required on all masonry surfaces exposed to the environment. Apply repellant after completion of adjoining elastomeric sealant work and initial cleaning of units. Apply material in accordance with manufacturer's printed instructions. Mask adjacent areas to avoid contamination of glass, EIFS and other adjacent surfaces. After 21 days, spray water on coated surfaces and recoat any absorptive surfaces.

3.12 EXPANSION AND CONTROL JOINTS

Joints shall be located where indicated and as specified. Joint geometry shall be of the size and details shown. Vertical joints shall not be spaced greater than 9000 mm apart in the field of the wall. Provide vertical joints at all inside corners. At outside building corners provide a joint on each side of the corner spaced not more than 1500 mm from the corner. Locate joints symmetrically across the face of the building. Joints shall be placed centered between adjacent openings where possible. Avoid locating joints where they will be interrupted by door, window or louver openings. Joints shall be constructed from foundation to top of wall without deviation from vertical. Horizontal joints shall be provided at shelf angles installed to limit the bearing height of brick veneer.

3.13 BOND BREAKS

At locations where brick veneer is in contact with a dissimilar material, such as pre-cast concrete or concrete masonry, a bond break shall be installed. Bond break shall be a layer of No. 15 asphalt felt or sheet metal flashing located between the dissimilar material and the adjacent mortar joint.

3.14 PROTECTION

Facing materials shall be protected against staining. Top of walls shall be covered with nonstaining waterproof covering or membrane when work is not in progress. Covering of the top of the unfinished walls shall continue until the wall is waterproofed with a complete roof or parapet system. Covering shall extend a minimum of 600 mm down on each side of the wall and shall be held securely in place. Before starting or resuming, top surface of masonry in place shall be cleaned of loose mortar and foreign material.

3.15 TEST REPORTS

3.15.1 Field Testing of Mortar

At least three specimens of mortar shall be taken each day. A layer of mortar 13 to 16 mm thick shall be spread on the masonry units and allowed to stand for one minute. The specimens shall then be prepared and tested for compressive strength in accordance with ASTM C 780.

3.15.2 Field Testing of Grout

Field sampling and testing of grout shall be in accordance with the applicable provisions of ASTM C 1019. A minimum of three specimens of grout per day shall be sampled and tested. Each specimen shall have a minimum ultimate compressive strength of 13.8 MPa at 28 days.

3.15.3 Efflorescence Test

Brick which will be exposed to weathering shall be tested for efflorescence. Tests shall be scheduled far enough in advance of starting masonry work to permit retesting if necessary. Sampling and testing shall conform to the applicable provisions of ASTM C 67. Rating of units tested shall be "not effloresced" or brick will be subject to rejection. Mortar and grout shall be tested consistent with the procedures described in paragraph 1.5.2.

END OF SECTION

SECTION 05090
WELDING, STRUCTURAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design, Plastic Design
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AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
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AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
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AWS A3.0	(1994) Standard Welding Terms and Definitions
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AWS D1.1	(2000) Structural Welding Code - Steel
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AWS Z49.1	(1999) Safety in Welding and Cutting and Allied Processes
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FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 353	(2000) Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications
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1.2 DEFINITIONS

Definitions of welding terms shall be in accordance with AWS A3.0.

1.3 GENERAL REQUIREMENTS

The design of welded connections shall conform to AISC ASD Spec unless otherwise indicated or specified. Material with welds will not be accepted unless the welding is specified or indicated on the drawings or otherwise approved. Welding shall be as specified in this section, except where additional requirements are shown on the drawings or are specified in other sections. Welding shall not be started until welding procedures, inspectors,

nondestructive testing personnel, welders, welding operators, and tackers have been qualified and the submittals approved by the Contracting Officer. Qualification testing shall be performed at or near the work site. Each Contractor performing welding shall maintain records of the test results obtained in welding procedure, welder, welding operator, and tacker performance qualifications.

1.3.1 Pre-erection Conference

A pre-erection conference shall be held, prior to the start of the field welding, to bring all affected parties together and to gain a mutually clear understanding of the project and the Welding Procedure Specifications (WPS) (which the Contractor shall develop and submit for all welding, including welding done using prequalified procedures). Attendees shall include all Contractor's welding production and inspection personnel and appropriate Government personnel. Items for discussion could include: responsibilities of various parties; welding procedures and processes to be followed; welding sequence (both within a joint and joint sequence within the building); inspection requirements and procedures, both visual and ultrasonic; welding schedule; fabrication of mock-up model; and other items deemed necessary by the attendees.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Welding Procedure Qualifications; G. Welder, Welding Operator, and Tacker Qualification; G
Inspector Qualification; G. Previous Qualifications; G
Prequalified Procedures; G

Copies of the welding procedure specifications; the procedure qualification test records; and the welder, welding operator, or tacker qualification test records.

SD-06 Test Reports

Quality Control; G

A quality assurance plan and records of tests and inspections.

1.5 WELDING PROCEDURE QUALIFICATIONS

Except for prequalified (per AWS D1.1) and previously qualified procedures, each Contractor performing welding shall record in detail and shall qualify the welding procedure specification for any welding procedure followed in the fabrication of weldments. Qualification of welding procedures shall conform to AWS D1.1 and to the specifications in this section. Copies of the welding procedure specification and the results of the procedure qualification test for each type of welding which requires procedure qualification shall be submitted for approval. Approval of any procedure, however, will not relieve the Contractor of the sole responsibility

for producing a finished structure meeting all the requirements of these specifications. This information shall be submitted on the forms in Appendix E of AWS D1.1. Welding procedure specifications shall be individually identified and shall be referenced on the detail drawings and erection drawings, or shall be suitably keyed to the contract drawings. In case of conflict between this specification and AWS D1.1, this specification governs.

1.5.1 Previous Qualifications

Welding procedures previously qualified by test may be accepted for this contract without requalification if the following conditions are met:

- a. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- b. The qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- c. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.5.2 Prequalified Procedures

Welding procedures which are considered prequalified as specified in AWS D1.1 will be accepted without further qualification. The Contractor shall submit for approval a listing or an annotated drawing to indicate the joints not prequalified. Procedure qualification shall be required for these joints.

1.5.3 Retests

If welding procedure fails to meet the requirements of AWS D1.1, the procedure specification shall be revised and requalified, or at the Contractor's option, welding procedure may be retested in accordance with AWS D1.1. If the welding procedure is qualified through retesting, all test results, including those of test welds that failed to meet the requirements, shall be submitted with the welding procedure.

1.6 WELDER, WELDING OPERATOR, AND TACKER QUALIFICATION

Each welder, welding operator, and tacker assigned to work on this contract shall be qualified in accordance with the applicable requirements of AWS D1.1 and as specified in this section. Welders, welding operators, and tackers who make acceptable procedure qualification test welds will be considered qualified for the welding procedure used.

1.6.1 Previous Personnel Qualifications

At the discretion of the Contracting Officer, welders, welding operators, and tackers qualified by test within the previous 6 months may be accepted for this contract without requalification if all the following conditions are met:

- a. Copies of the welding procedure specifications, the procedure qualification test records, and the welder, welding operator, and tacker qualification test records are submitted and approved in accordance with the specified requirements for detail drawings.
- b. Testing was performed by an approved testing laboratory, technical consultant, or the Contractor's approved quality control organization.
- c. The previously qualified welding procedure conforms to the requirements of this specification and is applicable to welding conditions encountered under this contract.
- d. The welder, welding operator, and tacker qualification tests conform to the requirements of this specification and are applicable to welding conditions encountered under this contract.

1.6.2 Certificates

Before assigning any welder, welding operator, or tacker to work under this contract, the Contractor shall submit the names of the welders, welding operators, and tackers to be employed, and certification that each individual is qualified as specified. The certification shall state the type of welding and positions for which the welder, welding operator, or tacker is qualified, the code and procedure under which the individual is qualified, the date qualified, and the name of the firm and person certifying the qualification tests. The certification shall be kept on file, and 3 copies shall be furnished. The certification shall be kept current for the duration of the contract.

1.6.3 Renewal of Qualification

Requalification of a welder or welding operator shall be required under any of the following conditions:

- a. It has been more than 6 months since the welder or welding operator has used the specific welding process for which he is qualified.
- b. There is specific reason to question the welder or welding operator's ability to make welds that meet the requirements of these specifications.
- c. The welder or welding operator was qualified by an employer other than those firms performing work under this contract, and a qualification test has not been taken within the past 12 months. Records showing periods of employment, name of employer where welder, or welding operator, was last employed, and the process for which qualified shall be submitted as evidence of conformance.
- d. A tacker who passes the qualification test shall be considered eligible to perform tack welding indefinitely in the positions and with the processes for which he is qualified, unless there is some specific reason to question the tacker's ability. In such a case, the tacker shall be required to pass the prescribed tack welding test.

1.7 INSPECTOR QUALIFICATION

Inspector qualifications shall be in accordance with AWS D1.1. The inspector in responsible charge shall have an AWS CWI QC1 certification. Nondestructive testing personnel shall be

qualified in accordance with the requirements of ASNT RP SNT-TC-1A for Levels I or II in the applicable nondestructive testing method. The inspector may be supported by assistant welding inspectors who are not qualified to ASNT RP SNT-TC-1A, and assistant inspectors may perform specific inspection functions under the supervision of the qualified inspector.

1.8 SYMBOLS

Symbols shall be in accordance with AWS A2.4, unless otherwise indicated.

1.9 SAFETY

Safety precautions during welding shall conform to AWS Z49.1.

PART 2 PRODUCTS

2.1 WELDING EQUIPMENT AND MATERIALS

All welding equipment, electrodes, welding wire, and fluxes shall be capable of producing satisfactory welds when used by a qualified welder or welding operator performing qualified welding procedures. All welding equipment and materials shall comply with the applicable requirements of AWS D1.1.

PART 3 EXECUTION

3.1 WELDING OPERATIONS

3.1.1 Requirements

Workmanship and techniques for welded construction shall conform to the requirements of AWS D1.1 and AISC ASD Spec. When AWS D1.1 and the AISC ASD Spec specification conflict, the requirements of AWS D1.1 shall govern.

3.1.2 Identification

Welds shall be identified in one of the following ways:

- a. Written records shall be submitted to indicate the location of welds made by each welder, welding operator, or tacker.
- b. Each welder, welding operator, or tacker shall be assigned a number, letter, or symbol to identify welds made by that individual. The Contracting Officer may require welders, welding operators, and tackers to apply their symbol next to the weld by means of rubber stamp, felt-tipped marker with waterproof ink, or other methods that do not cause an indentation in the metal. For seam welds, the identification mark shall be adjacent to the weld at 1 meter intervals. Identification with die stamps or electric etchers shall not be allowed.

3.2 QUALITY CONTROL

Testing shall be done by an approved inspection or testing laboratory or technical consultant; or if approved, the Contractor's inspection and testing personnel may be used instead of the commercial inspection or testing laboratory or technical consultant. The Contractor shall

perform nondestructive testing (MT and UT) on all moment frame connections in accordance with the frequency and methods stated in Table 6-3 of FEMA 353 and the contract drawings. For welded connections for beams, other than moment connections, the Contractor shall perform visual and dye penetrant inspection to determine conformance with paragraph STANDARDS OF ACCEPTANCE. Procedures and techniques for inspection shall be in accordance with applicable requirements of AWS D1.1, except that in radiographic inspection only film types designated as "fine grain," or "extra fine," shall be employed. The inspector in responsible charge shall write a statement of responsibility to the Contracting Officer for each building. They shall state that all welds have been inspected in accordance to AWS D1.1 and the contract drawings, and will indicate any locations of defective work.

3.3 STANDARDS OF ACCEPTANCE

Dimensional tolerances for welded construction, details of welds, and quality of welds shall be in accordance with the applicable requirements of AWS D1.1 and the contract drawings. Nondestructive testing on welded shear connections for beams, other than moment connections, shall be by visual inspection and dye penetrant methods. The minimum extent of nondestructive testing for welded shear connections shall be random 10 percent of welds or joints, as indicated on the drawings. Nondestructive testing shall be performed on all moment connections and full penetrations welds. All field welds shall be visually inspected in accordance with AWS D1.1.

3.3.1 Nondestructive Examination

The welding shall be subject to inspection and tests in the mill, shop, and field. Inspection and tests in the mill or shop will not relieve the Contractor of the responsibility to furnish weldments of satisfactory quality. When materials or workmanship do not conform to the specification requirements, the Government reserves the right to reject material or workmanship or both at any time before final acceptance of the structure containing the weldment.

3.3.2 Destructive Tests

When metallographic specimens are removed from any part of a structure, the Contractor shall make repairs. The Contractor shall employ qualified welders or welding operators, and shall use the proper joints and welding procedures, including peening or heat treatment if required, to develop the full strength of the members and joints cut and to relieve residual stress.

3.4 GOVERNMENT INSPECTION AND TESTING

In addition to the inspection and tests performed by the Contractor for quality control, the Government will perform inspection and testing for acceptance to the extent determined by the Contracting Officer. The costs of such inspection and testing will be borne by the Contractor if unsatisfactory welds are discovered, or by the Government if the welds are satisfactory. The work may be performed by the Government's own forces or under a separate contract for inspection and testing. The Government reserves the right to perform supplemental nondestructive and destructive tests to determine compliance with paragraph STANDARDS OF ACCEPTANCE.

3.5 CORRECTIONS AND REPAIRS

When inspection or testing indicates defects in the weld joints, the welds shall be repaired using a qualified welder or welding operator as applicable. Corrections shall be in accordance with the requirements of AWS D1.1 and the specifications. Defects shall be repaired in accordance with the approved procedures. Defects discovered between passes shall be repaired before additional weld material is deposited. Wherever a defect is removed and repair by welding is not required, the affected area shall be blended into the surrounding surface to eliminate sharp notches, crevices, or corners. After a defect is thought to have been removed, and before rewelding, the area shall be examined by suitable methods to ensure that the defect has been eliminated. Repair welds shall meet the inspection requirements for the original welds. Any indication of a defect shall be regarded as a defect, unless reevaluation by nondestructive methods or by surface conditioning shows that no unacceptable defect is present. Immediately recertify, or replace with qualified welders, those welders that have passed qualification tests but are producing unsatisfactory welding.

END OF SECTION

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SECTION 05091

ULTRASONIC INSPECTION OF WELDMENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR NONDESTRUCTIVE TESTING (ASNT)

ASNT RP SNT-TC-1A	(1996) Recommended Practice SNT-TC-1A
ASNT Q&A Bk C	(1994) Question and Answer Book C: Ultrasonic Testing Method; Levels I, II, III (Supplement to RP SNT-TC-1A)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 165	(1995) Liquid Penetrant Examination
ASTM E 709	(1995) Magnetic Particle Examination

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code – Steel
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FEDERAL EMERGENCY MANAGEMENT AGENCY (FEMA)

FEMA 353	(2000) Recommended Specifications and Quality Assurance Guidelines for Steel Moment-Frame Construction for Seismic Applications
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1.2 DEFINITIONS

1.2.1 A Scan

Method of data presentation on a cathode ray tube using rectangular coordinates in which a horizontal base line indicates elapsed time when reading from left to right. A vertical deflection in the base line indicates reflect signal amplitude.

1.2.2 Acoustically Similar Material

Material the same as that to be inspected; or another material proven to have acoustical velocity within plus or minus 3 percent and an attenuation within plus or minus 0.009843 dB/mm (0.25 dB/inch) of the inspected material for the inspection frequency and wave mode, using the same mode as that to be used for inspection.

1.2.3 Amplitude

When referring to an indication in A scan presentation, amplitude is the vertical height of the indication measured from peak-to-peak for radio frequency indications and trace-to-peak for video indications.

1.2.4 Attenuation

Dissipation or loss of energy as ultrasonic vibrations travel through the material. Attenuation is caused almost entirely by scattering of the ultrasonic vibrations generated by the search unit.

1.2.5 Attenuation-Correction Controls

Circuitry to provide a continuous increase in amplification with respect to time. This circuitry compensates for the reduction in sensitivity with depth as a result of sound beam divergence and its attenuation in material.

1.2.6 Back Reflection or End Reflection

Reflection from the opposite side, end, or boundary of the material into which the ultrasonic energy was introduced.

1.2.7 Calibrated Gain Control (Attenuator)

Circuitry with which gain can be reduced finite amounts by switching electrical signal attenuation into the circuit.

1.2.8 Calibration

Process of comparing an instrument or device with a standard to determine accuracy or produce a scale.

1.2.9 Cathode Ray Tube (CRT)

An electron tube in which a controlled beam of electrons from the cathode is used to produce an image on a fluorescent screen at the end of the tube.

1.2.10 Couplant

Any material, usually a liquid or semiliquid, used between the search unit and the inspection surface to exclude air and to convey the ultrasonic vibrations between the search unit and the material being inspected.

1.2.11 Damping Control

Control that varies the duration of transducer ringing.

1.2.12 Decibel (dB)

Units for the logarithmic expression of the ratio of power levels. Power levels can be functions of voltage, current, or impedance, for example. Decibel units having no values of their own are only significant when a reference is stated, as 10 dB above one reference level or 6 dB below another reference level.

1.2.13 Delay Control

Means of delaying the pattern obtained on the CRT.

1.2.14 Discontinuity

Anything within a material that will cause a detectable interruption in an ultrasonic beam.

1.2.15 Distance-Amplitude Correction Curve

Curve showing the relationship between signal amplitude and equal-sized reflecting surfaces at various distances from the transducer. Reference standards are used to obtain such curves.

1.2.16 Dynamic Range

Ratio of maximum to minimum size of reflective areas that can be adequately distinguished on the CRT at a constant gain setting.

1.2.17 Effective Depth of Penetration

Maximum depth at which the sensitivity is satisfactory for the quality of test desired.

1.2.18 Examination

Within the context of this specification, examination is equivalent to the word "inspection."

1.2.19 Gain Control

Circuitry designed into the ultrasonic system to vary reflection amplitude. This control is usually calibrated in decibels. It is also called the sensitivity control.

1.2.20 Gross

Background displacement of the trace on the CRT from the established baseline due to the gain setting, the characteristics of the test equipment, or the material under examination.

1.2.21 Hertz

One complete set of recurrent values of a periodic quantity comprises a cycle. In other words, any one set of periodic variations starting at one condition and returning once to the same condition is a cycle.

1.2.22 Immersion Techniques

Test methods in which the part to be tested and the search units are immersed in water or other suitable liquid couplant. A mechanical device is used to firmly hold and direct the wave angle of the search unit. The search unit does not contact the item being inspected.

1.2.23 Indication

Visual presentation on the cathode ray screen resulting from a sound beam reflection from a boundary surface or discontinuity.

1.2.24 Initial Pulse Indication

Usually called the "initial pulse". A signal on the CRT screen marking the instant at which a voltage impulse is applied to the transmitting crystal. Its rising edge is frequently invisible due to the time lag in the probe shoe and the consequent necessity to ensure coincidence between the time base zero and the instant at which the transmitter pulse actually enters the material under test.

1.2.25 Linearity

Property of an instrument revealed by a linear change in reflected signal or displacement. The vertical linearity is determined by plotting the change in ratios of signal amplitude from two adjacent reflections from an area of known size. The horizontal linearity is determined by plotting the distance the signal is displaced along the sweep against the change in material thickness or by noting the spacing of multiple back reflections.

1.2.26 Longitudinal or Compressional Waves

Simple compression-rarefaction waves in which particle motion within a material is linear and in the direction of wave propagation. Also called straight beams, or compressional or normal waves.

1.2.27 Longitudinal Wave Inspection

Ultrasonic technique, normally using straight beam methods, in which longitudinal waves are the dominant form.

1.2.28 Mid-Screen Reflection

Reflection whose amplitude is equal to one-half the useable screen height on the CRT.

1.2.29 Megahertz (MHz)

One million hertz per second frequency.

1.2.30 NDT Level I

An NDT Level I individual should be qualified to properly perform specific calibrations, specific NDT, and specific evaluations for acceptance or rejection determinations according to written instructions, and to record results.

1.2.31 NDT Level II

An NDT Level II individual should be qualified to set up and calibrate equipment and to interpret and evaluate results with respect to applicable codes, standards, and specifications.

1.2.32 NDT Level III

An NDT Level III individual should be capable of establishing techniques and procedures; interpreting codes, standards, specifications, and procedures; and designating the particular NDT methods, techniques, and procedures to be used.

1.2.33 Node

Distance a shear wave travels in a straight line from the inspection surface before being reflected by the opposite surface.

1.2.34 Pulse Repetition Rate

Number of spaced pulses of sound per second sent into the material being inspected.

1.2.35 Range Control

Means of expanding the pattern obtained on the CRT so that any portion of the total distance being tested can be presented.

1.2.36 Reference Reflector

Standard reflector 1.52 mm (0.06 inch) 0.06 inch diameter reference hole in the IIW reference block. Other approved blocks may have a different diameter reflector.

1.2.37 Reflector

Boundary, consisting of an opposite side, crack, or separation, or a distinct change in material such as slag or porosity that reflects the ultrasonic energy the same as a mirror reflects light.

1.2.38 Refracted Waves

Waves that have undergone change of velocity and direction by passing from one material to another material with different acoustical properties. Refraction will occur wherever the angle of the incident wave to the interface is other than perpendicular.

1.2.39 Rejectable Discontinuity (Defect)

Reflector large enough to produce a signal (decibel rating) that exceeds the reject/repair line.

1.2.40 Resolution

Ability to clearly distinguish signals obtained from two reflective surfaces with a minimum separation distance. Near-surface resolution is the ability to clearly distinguish a signal from a reflector at a minimum distance under the contact or near surface without interference from

the initial pulse signal. Far-surface resolution is the ability to clearly distinguish signals from reflectors displaced at minimum distances from the far or back surface when the sound beam is normal to that back surface.

1.2.41 Ringing

Excitation in a transducer due to the application of a short pulse of high voltage.

1.2.42 Scanning

Procedure of moving the search unit or units along a test surface to obtain complete inspection of the entire volume of a material being inspected. Preliminary scanning refers to a somewhat common practice of rapidly traversing a weld ultrasonically with a higher instrument gain or sensitivity level than will be used for the evaluation. It gives the operator an estimate of the welding quality and also makes all defects more prominent and less likely to be missed.

1.2.43 Search Unit

Device containing a piezoelectric material used for introducing vibrations into a material to be inspected or for receiving the vibrations reflected from the material. The active element of the search unit is defined as the effective transmitting area. Search units are also called transducers or probes. They may be single or dual and contain one or two piezoelectric elements, respectively, for transmission and reception. The single search unit is sometimes enclosed in a transducer wheel or search unit wheel. The search unit may be manually handled and placed in direct contact with the material to be inspected or may be held in a fixture for immersion techniques.

1.2.44 Sensitivity

Measure of the ultrasonic equipment's ability to detect discontinuities. Quantitatively, it is the level of amplification of the receiver circuit in the ultrasonic instrument necessary to produce the required indication on the scope from the reference hole in the reference block. Also see "Standard Reference Level."

1.2.45 Shear Waves

Waves in which the particles within the material vibrate perpendicularly to the direction in which the wave travels or propagates. Also called transverse waves.

1.2.46 Shear Wave Inspection

Inspection technique using shear waves in a material. The search unit is placed at an angle to the contact surface of the material so the resultant refracted sound is a shear wave at an angle to the normal.

1.2.47 Standard Reference Level

Mid-screen height reflection when beaming at the 1.52 mm (0.06 inch) 0.06 inch hole in the primary reference block or the reference hole in the secondary standard.

1.2.48 Surface Waves

Waves that propagate along the surface of the material and penetrate it to only about 1/2-wavelength. Also known as Rayleigh waves.

1.2.49 Test Frequency

Operating frequency in hertz per second of the search unit during period of activation. Frequency is usually expressed in megacycles per second or megahertz. The latter term has been adopted for international use and is preferred.

1.2.50 Video Form

Type of signal presentation on a CRT in which only the upper half of the signal appears.

1.3 GENERAL REQUIREMENTS

The procedures, methods, standards, and description of equipment specified herein shall be used for inspection of weldments for moment frame connections and all complete penetration welds. Nondestructive testing shall be made to detect the following defects:

- a. Cracks or crack-like faults.
- b. Root defects, including lack of penetration and fusion.
- c. Lack of fusion between passes on the sidewall.
- d. Porosity or inclusions and excessive undercutting.

Frequency of testing and testing method requirements for moment connections shall be in conformance with Table 6-3 of FEMA 353 and the contract drawings.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Ultrasonic Inspection; G.

Procedures and Methods. The pulse echo contact method with an A scan presentation shall be used for the ultrasonic inspection of welded joints, except that immersion techniques may be used for some applications when approved by the Contracting Officer. The Contractor shall provide a standard reference block and working standards as described in paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION. The procedures to be used for personnel and equipment qualification, equipment calibration, and

inspection, shall be submitted to the Contracting Officer at least 30 days prior to their intended use. Approval by the Government will in no way affect the obligation of the Contractor to employ qualified personnel, equipment, and procedures, and to perform the inspection as specified. The procedure description shall include the following:

- a. Couplant.
- b. Search unit characteristics including angle, size, shape, nominal frequency, type designation.
- c. Method and type of wave.
- d. Equipment and accessories including manufacturer, model number, date of manufacture, last date of calibration, and the manufacturer's electrical, physical, and performance specifications.
- e. Decibel (dB) compensation system for distance-amplitude correction.

Reports containing the following information:

- a. Identification and Location of Inspected Item: Name and place of the inspected item, the person performing the inspection, and the date of inspection.
- b. Detail of Inspections: Details of methods, types of waves used, search units, frequencies, inspection equipment identification, and calibration data with enough information to permit duplication of the inspection at a later date.
- c. Response in Calibration: The response from the DSC or SC block used in calibration and for acceptance/rejection in terms of the response from the 1.524 mm (0.06 inch) reference hole in the standard IIW block (primary standard).
- d. Identification of Unacceptable Areas: Locations, dimensions, types, and area of unacceptable defects and discontinuities giving reflections over 50 percent of the reject/repair line. These may be noted on a sketch or marked-up drawing.
- e. Record of Repair Areas: A record of repaired areas shall be furnished as well as test results for the repaired areas.

1.5 WAVE TYPES

The types of waves and the conditions under which they shall be used are specified below:

1.5.1 Shear Waves

Unless conditions prohibit, shear waves shall be used. A longitudinal wave procedure may be used instead, if approved by the Contracting Officer. Refracted waves between 40 degrees and 70 degrees shall be used except where different angles are indicated in approved procedures, such as for materials less than 13 mm thick, for materials with sound velocities greater than in steel, when the weldments are not readily accessible, or when existing backing rings or backing strips are not removed. For inspection of weldments

containing backing rings or backing strips, the instrument shall be adjusted and the refracted angles shall be selected in a way to separate the weldment and the backing ring reflections. The search unit angle and the resulting shear wave angle in the material to be inspected shall be established by the Contractor for each application and this information shall be included in the procedure submitted for approval.

1.5.2 Longitudinal Waves

When conditions prohibit the use of shear waves, longitudinal waves may be used. The procedure shall be specially developed to suit the application and shall have the prior approval of the Contracting Officer.

1.6 CHANGES IN PROCEDURE

Should application of an approved procedure not provide for good resolution or adequate ultrasonic penetration in the items to be inspected (see paragraph EQUIPMENT QUALIFICATION REQUIREMENTS), changes in procedure or equipment such as frequency, pulse repetition rate, angle of search unit, couplant, or oscilloscope shall be made by the Contractor. Adequacy of the new procedure shall be demonstrated to the Contracting Officer. The Government reserves the right to require a change in test equipment during these tests if any of the following test system characteristics fall below the levels listed in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS: sensitivity, amplitude and distance linearity, signal-to-noise ratio, entry and back surface resolution and penetration.

1.7 ULTRASONIC EQUIPMENT

The ultrasonic equipment shall conform to the requirements listed in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment, with the following exceptions:

- a. The ultrasonic test instruments shall be able to generate, receive, and to present pulses in the frequency range from 1 to 10 megahertz (MHz).
- b. The horizontal linearity of the ultrasonic instrument shall be measured in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.
- c. In addition to the resolution test specified in AWS D1.1, subsection Ultrasonic Equipment, both near- and far-surface resolution tests shall be conducted in accordance with the tests specified for these characteristics in the paragraph EQUIPMENT QUALIFICATION REQUIREMENTS.

1.8 PERSONNEL QUALIFICATION AND REQUIREMENTS

1.8.1 Personnel Qualification

The three levels of responsibility associated with ultrasonic inspection are defined in ASNT RP SNT-TC-1A. For qualification to perform ultrasonic inspection, personnel shall be certified under ASNT RP SNT-TC-1A and ASNT Q&A Bk C within a period of 1 year before the date of contract. Other qualification or certification may be accepted at the Contracting Officer's discretion. Personnel with only an operator or inspector trainee certification will not be considered qualified to pass judgement on the acceptability of inspected items, but may work under the direct supervision of a qualified ultrasonic inspector. Qualified ultrasonic inspectors

shall be able to judge the acceptability of the item in accordance with paragraph ACCEPTANCE/REJECTION LIMITS.

1.8.2 Examinations

If the Contracting Officer doubts an individual's ability as an operator, inspector, or supervisor, the individual shall be recertified in accordance with ASNT RP SNT-TC-1A. At the option of the Government, the Contracting Officer may participate in administering the examination and in evaluating the results.

1.9 REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION

Reference standards shall be used to calibrate the inspection equipment, test its operating condition, and record the sensitivity or response of the equipment during the inspection in accordance with paragraph EQUIPMENT QUALIFICATION REQUIREMENTS. The standards shall comprise a standard reference block and reference specimens as noted below.

1.9.1 Standard Reference Block

The standard reference block or primary standard shall be provided by the Contractor and shall consist of the IIW block in AWS D1.1, Section Inspection, subsection Reference Standards. The standard reference block also shall be used in any reinspection on the same basis as the original inspection, even though the reinspection is to be performed by other ultrasonic instruments and accessories.

1.9.2 Working Standards

The Contractor may use other recognized working standards detailed with the IIW block in AWS D1.1 such as the Sensitivity Calibration (SC) block. However, such blocks shall be referenced to the IIW block as noted in paragraph SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS. Details of their use shall be included in the procedure description submitted to the Contracting Officer. These blocks are the secondary standards. They shall be of acoustically similar material to the welds to be inspected. The secondary standards shall be suited for the applicable tests specified in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS and shall be used as follows, except where the IIW block is specifically required:

- a. To assure adequate penetration of the base material.
- b. To provide a secondary field standard.
- c. To calibrate the equipment and establish the standard reference level.

1.9.3 Resolution Test Block

The Contractor shall furnish a resolution test block in accordance with the details shown in AWS D1.1 Section Inspection, subsection Ultrasonic Equipment.

1.10 EQUIPMENT QUALIFICATION REQUIREMENTS

The ultrasonic instrument and accessories shall be evaluated on their arrival at the jobsite, immediately prior to the start of inspection. They shall be evaluated using the Contractor's furnished primary standard and shall meet or exceed the requirements listed in paragraphs below. Equipment that does not meet these requirements shall not be used in the inspection.

1.10.1 Requalifications

The equipment shall be requalified after normal use at intervals not to exceed 40 hours, except as noted. The equipment also shall be requalified immediately after maintenance or repair or when the Contracting Officer considers its operation questionable.

1.10.2 Longitudinal Wave System

1.10.2.1 Vertical Amplitude Linearity

Two adjacent reflections of different amplitudes obtained through the thickness of the primary or secondary standard shall vary in the same proportion as the amplitude of the first reflection is increased in discrete 2-dB increments between 20 percent and 80 percent to full screen height. For each gain setting, the amplitude of each reflection shall vary by the same factor, within plus or minus 5 percent. Requalification is required monthly or as otherwise stated.

1.10.2.2 Horizontal Linearity

The first three multiple reflections obtained through the thickness of the primary or secondary standard shall be equally spaced, within plus or minus 5 percent, when spread over 90 percent of the sweep length. Requalification is required monthly or as otherwise stated.

1.10.2.3 Near-Surface Resolution

Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed a 13 mm equivalent distance in steel with the search unit placed on the 100 mm edge of the IIW (primary) block and positioned for maximum amplitude reflection from the 1.524 mm (0.06 inch) reference hole of the primary standard. The reference reflector shall be set to mid-screen and the gain shall be increased 20 dB. The reference hole located at least 13 mm from one edge of the AW DSC or SC secondary standard shall be used similarly. Acceptability will be on the same basis as in the primary standard.

1.10.2.4 Far-Surface Resolution

This property of the equipment shall be verified by the method detailed in AWS D1.1, Section Inspection, subsection Calibration of the Ultrasonic Unit with the IIW or Other Approved Calibration Blocks. In addition, the trailing edge of the third reflection shall return to the sweep line and be clearly discernible.

1.10.3 Angle Wave System

1.10.3.1 Vertical (Amplitude) Linearity

Two adjacent multiple reflections from the 1.524 mm reference hole in the primary standard shall vary in the same proportion as the amplitude of the first reflection in discrete 2-dB increments between 20 percent and 80 percent of full screen height. For each gain setting, the amplitude of each adjacent reflection shall vary within plus or minus 5 percent. For testing with the AWS SC or AWS DSC secondary standard, the same criteria shall apply. For the SC block, the transducer shall be placed on the longitudinal surface contiguous with the sound entry point lines, whereas the 100 mm longitudinal surface of the DSC block shall be used for the same purpose. Requalification is required monthly, or as otherwise stated.

1.10.3.2 Horizontal Linearity (Angle Wave)

The first three multiple echoes, obtained from the 1.524 mm (0.06 inch) inch reference hole of the primary standard or from the reference hole in a secondary standard with the transducer positioned at a minimum of 25 mm (1 inch) 1 inch sound path distance, shall be equally spaced plus or minus 5 percent when spread over 90 percent of the sweep length. The gain shall be adjusted to give a mid-screen height first reflection. Requalification is required monthly or as otherwise stated.

1.10.3.3 Near-Surface Resolution (Angle Wave)

The search unit shall be positioned for maximum amplitude using the primary or secondary standard as in the horizontal linearity test. The gain shall be adjusted to give a mid-screen height first reflection and then shall be increased 20 dB. Excessive ringing that appears on the CRT to the right of the sound entry point shall not exceed 13 mm equivalent distance in steel.

1.10.3.4 Far-Surface Resolution (Angle Wave)

The equipment shall delineate the three resolution holes in the resolution block appropriate for the angle of the transducer to be used in the inspection.

1.10.3.5 Signal-to-Noise Ratio

With the search unit located as in the horizontal linearity test, the gain shall be set to obtain an 80 percent full screen height first reflection. The reference reflection-to-noise-amplitude ratio shall not be less than 10 to 1.

1.10.3.6 Exit Point

The search unit shall be placed on the graduated scale on the 300 mm edge of the primary standard and the ultrasound shall be beamed toward the curved edge of the block. The gain shall be set for a mid-screen first reflection. The search unit shall be moved back and forth until the first reflection is maximized. The index line on the side of the search unit shall be within 1.6 mm of the mid-point of the graduated scale in either direction. Requalification is required after 40 hours or as otherwise stated.

1.10.3.7 Transducer Angle

The established exit point of the probe shall be set over the applicable angle index line scribed on the 200 mm or 300 mm edge, as appropriate, of the primary standard. The gain shall be set to obtain a mid-screen first reflection from the 50 mm plexiglass-lined hole for search units up to 70 percent with the search unit placed on the 200 mm edge. Search units of large angles that have been approved specifically by the Contracting Officer shall be tested from the 300 mm edge using the 1.524 mm reference hole. The search unit shall be moved back and forth to maximize the first reflection. When the material to be inspected is not acoustically similar to the primary standard, the inspection angle shall be within plus or minus 2 degrees of the angle specified in the approved procedure. Requalification is required after 40 hours or as otherwise stated.

1.11 SENSITIVITY CALIBRATION OF LONGITUDINAL AND ANGLE WAVE SYSTEMS

Sensitivity calibration shall be done immediately after a change of operators and at least every 30 minutes thereafter as testing proceeds. Recalibration will be required after any power interruption, including a change of source, when the equipment is suspected of being in error, or after relocation of the jobsite. The 30-minute and relocation calibrations may coincide. The instrument shall be allowed to warm up before calibration is attempted. The instrument range and delay controls shall be adjusted to display signals from the reference hole in the primary (IIW block) or secondary standard (DSC or SC block or both) on the viewing screen for the range of distances to be inspected.

1.11.1 Calibration Procedure

The test instrument shall be calibrated as described below.

1.11.1.1 Longitudinal Wave

In calibrating with the primary standard, the transducer shall be positioned on the 100 mm edge for maximum reflection from the 1.524 mm reference hole. The gain shall be adjusted so that the first reflection is at 50 percent full scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. If a secondary standard is to be used in the inspection, the reject/repair line shall be established similarly. For the DSC block, the transducer shall be positioned on the 100 mm long surface and with the SC degrees sound entry point lines. Adjustment for loss of signal due to distance shall be compensated for as noted above.

1.11.1.2 Angle Wave

In calibrating with either the primary or secondary standard, the transducer shall be positioned on the same surfaces as in the case of the longitudinal wave system but over the sound entry point lines appropriate for the angle of the transducer to be used in the inspection. The gain shall be adjusted to give a first reflection that is 50 percent of full-scale response. The top of that indication shall be marked with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair line. Loss of signal shall be compensated as noted.

1.11.2 Calibration of the Secondary Standards

After adjusting the first reflection from the reference hole in the secondary standard to 50 percent full-scale response for a shear or longitudinal wave inspection, a maximized reflection from the 1.524 mm reference hole in the primary standard shall be obtained without changing the gain setting. The gain setting shall be readjusted to obtain a 50 percent full-scale reflection and the readjusted setting shall be recorded as required to provide a basis for recalibration when the secondary standard is unavailable.

1.11.3 Equipment With a Calibrated Gain Control (Attenuator)

When a calibrated gain control attenuator is used, the transducer shall be positioned for a maximum reflection from the reference hole in the secondary standard representing approximately 1/2 the longest inspection distance. This reflection shall be adjusted to mid-scale by varying the gain control accordingly. The difference in decibels between this amplitude and the signal obtained from the first, second, and longest distance reflection obtainable on the secondary standard shall be measured. The differences shall be recorded and plotted on a curve to determine the necessary correction to the amplitude at the various inspection distances. A level of 80 percent of the primary level obtained from the corrected signal heights, is equivalent to the reject/repair line.

1.11.4 Equipment With Electronic Distance Compensation Circuitry

If the difference in amplitude between the first reflection and the reflection obtained from the maximum inspection distance is 1 dB or less, the instrument may be used as is. If not, the procedure used for equipment with a calibrated decibel control shall be used to determine the necessary correction to the reflections obtained at the various inspection distances. This characteristic of the equipment shall be re-examined on a monthly basis or as otherwise stated in paragraph EQUIPMENT QUALIFICATION REQUIREMENTS, and correction factors shall be modified accordingly.

1.11.5 Longitudinal Wave Distance-Amplitude Correction Curve

A distance-amplitude correction curve may be used instead of the calibrated gain control or the electronic circuitry for either the shear or longitudinal wave system as described below:

a. A shear wave distance-amplitude correction curve shall be constructed and drawn on the face of the cathode ray tube (CRT) for inspection of weldments in excess of 38 mm thick when the design of the test equipment permits. The reference hole in the secondary standard SC or DSC shall be used to construct the distance-amplitude correction curve for a minimum of three node points, 1, 2, and 3. The sensitivity of the instrument shall be adjusted to produce 50 percent full-scale response for the maximized primary reflection and the reject/repair line shall be constructed at 80 percent of the established distance-amplitude curve.

b. A longitudinal wave distance-amplitude correction curve shall be constructed and drawn on the face of the CRT when longitudinal waves are to be used in the inspection for material thicknesses exceeding 25 mm, if design of the test equipment permits. The reference hole in the secondary standard shall be used. Instrument sensitivity shall be adjusted to 50 percent full-scale of the maximized response from the reference hole at 1/2 maximum inspection distance. A reject/repair line shall be constructed at 80 percent of the

established distance-amplitude curve. The reflection amplitudes to define this curve shall be taken from the faces of the secondary sensitivity standards which are 25 mm, 50 mm and 1/2 maximum inspection distance, and the longest distance obtainable from the secondary standard, respectively, from the reference hole. When a correction curve cannot be drawn on the face of the CRT, one of the distance-amplitude correction methods noted above and submitted under the procedure description shall be applied in accordance with paragraph GENERAL REQUIREMENTS.

1.11.6 Longitudinal Wave Inspections Using Immersion Technique

The reference hole in a secondary standard shall be used for each different inspection distance. Repair/reject limits shall be established by immersing both the search unit and secondary standard in the liquid bath in which the inspection is to be conducted. The procedure noted below shall be used:

- a. The longitudinal waves from the search unit shall be directed toward the face of the secondary standard closest to the reference hole.
- b. The search unit shall be positioned for maximum response. The amplitude of reflection shall be adjusted to 50 percent full-scale. The top of that indication shall be marked on the CRT with a wax pencil or by other means. This establishes the standard reference level. A point at 80 percent of the standard reference level shall be calculated and marked. This locates the reject/repair point. The above shall be repeated for each different surface-to-hole distance to establish the reject/repair line.
- c. With the gain at the same setting and the primary standard and search unit in air, a maximized reflection shall be obtained from the 1.524 mm reference hole in the primary standard (IIW). Then, this gain setting shall be readjusted to obtain a 50 percent full-scale reflection. The readjusted setting shall be recorded as required to provide a basis for recalibration when the secondary standard is unavailable.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 PREPARATION OF MATERIALS FOR INSPECTION

Surfaces shall be free from the following:

3.1.1 Weld Spatter

Spattering or any roughness that interferes with free movement of the search unit or impairs transmission of the ultrasonic vibrations.

3.1.2 Irregularities

Those which could mask or be confused with defect indications.

3.1.3 Weld Backing Strips

Strips that are not to remain in place shall be removed and all sharp edges and valleys shall be eliminated by grinding or other mechanical means.

3.1.4 Dirt

All loose scale, rust, paint, and dirt shall be removed from the coupling surface.

3.2 INSPECTION PROCEDURE

When possible, all welds shall be examined from both sides of the weld and from one surface. If complete inspection cannot be accomplished from one surface, inspection shall be made from another surface that is part of the same joint. Preliminary scanning techniques using an increased instrument gain shall be used to locate possible defects. When possible, gain shall be increased to a minimum of twice (6 dB) the reference level setting. Final acceptance or rejection shall be evaluated with the equipment properly calibrated and the gain control set at the reference level. The reject/repair line shall be used to evaluate quality of the weld. If a periodic calibration check shows that the equipment is not operating properly or that the system's sensitivity has decreased more than 20 percent (2 dB) from the established sensitivity level, all welds inspected since the prior calibration shall be reexamined. If penetration of the shear waves is questionable, the angle search unit shall be placed in position on one side of the weldment with the waves directed through the weldment. A disconnected angle search unit, plastic or metal wedge or disk, or any good reflector shall be placed in the wave path of the search unit on the far side of the weld to reflect the sound. When good reflections cannot be obtained by either shear or longitudinal waves, the Contractor shall modify the procedures in accordance with paragraph GENERAL REQUIREMENTS.

3.2.1 Test Frequency

The test frequency for ferrous materials shall be as specified in AWS D1.1, Section Inspection, subsection Ultrasonic Equipment, except for thicknesses below 13 mm, frequencies between 2.25 and 5 MHz may be used to obtain increased sensitivity. For materials that are difficult to penetrate, any frequency within the operating range of the equipment may be used. The effective depth of penetration and sound beam divergency shall be demonstrated to the Contracting Officer. See also paragraph 1.3e for frequency of testing on moment frame connections.

3.2.2 Couplants

The choice of couplant is optional with the Contractor, except as follows:

- a. The couplant shall be the same as that used for equipment qualification and calibration.
- b. Couplants that may corrode the reference standards and material being tested or leave objectionable residues shall not be used.
- c. Oils shall not be used in systems intended to handle liquid oxygen.

d. Couplants shall be of the proper viscosity to give good coupling for the surface roughness.

3.2.3 Shear Wave Inspection

Shear wave inspection shall be performed as follows: The search unit shall be placed on the contact surface at a distance from the weld equal to that used when calibrating the equipment.

3.2.4 Longitudinal Flaws

To detect longitudinal flaws, the search unit shall be slowly moved toward and away from the weld far enough to cover its entire cross section, approximately 90 degrees to the weld centerline. The search unit shall be radially oscillated to the left and right, covering an angle of approximately 30 degrees. During the foregoing movement, the search unit shall be continually advanced parallel to the weld centerline. The rate of movement shall depend on the operator's ability to clearly see and identify all reflections. The amount of movement shall be calculated to ensure that the inspection distance will be great enough to traverse the weld.

3.2.5 Transverse Flaws

To detect transverse flaws when the welded surface is ground flush, the search unit shall be moved along the welded surface in each direction parallel to the centerline of the weld metal with the wave radiating parallel to the weld centerline. To detect transverse flaws when the welded surface is not ground flush, the search unit shall be moved parallel to the weld in each direction, on the adjacent base metal at the top of the weld, with the wave directed at an angle of 30 degrees to the weld centerline.

3.2.6 Longitudinal Wave Inspection

This inspection shall be made as follows:

- a. The search unit shall be placed on the contact surface with the wave directed in a straight line through any intervening base metal and through the weldment.
- b. The search unit shall then be moved slowly in a direction parallel to the weld centerline and zigzagged across an area equivalent to the welded thickness to make sure that waves penetrate the entire welded cross section.
- c. The rate of movement shall be dependent on the operator's ability to clearly see and identify all reflections.

3.3 GENERAL ACCEPTANCE/REJECTION REQUIREMENTS

Discontinuities shall be evaluated only when the ultrasonic equipment is calibrated properly. If discontinuities are detected, the sound beam shall be directed to maximize the signal amplitude. To determine the length of a discontinuity, the search unit shall be moved parallel to the discontinuity axis in both directions from the position of maximum signal amplitude. One-half the amplitude or a 6-dB increase in sensitivity from a point at which the discontinuity signal drops rapidly to the baseline shall be defined as the extremity of the discontinuity. At this point, the scanning surface shall be marked at the position indicated by the center of the

transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. For discontinuities with signal amplitudes exceeding full screen height, 50 percent of full screen shall be considered half-peak amplitude. At this point, the scanning surface shall be marked at the position indicated by the center of the transducer. This shall be repeated to determine the other extremity. The length of the discontinuity shall be defined as the distance between these two marks. The maximum signal amplitude, length, depth, and position within the inspection zone shall be determined and reported for discontinuities yielding a signal amplitude equal to or exceeding the reject/repair line. The minimum recordable length of a discontinuity shall be 3 mm.. When evaluating welds joining two members with different thicknesses at the weld, the thickness T shall be the lesser of the two thicknesses. The criteria for acceptance or rejection based on ultrasonic inspection will supplement a visual inspection. The sizes and surface conditions of the welds shall conform to the requirements indicated on the applicable plans and drawings and other sections of the specification. When ultrasonic inspection is used along with radiography, the limits specified under paragraph REFERENCE STANDARDS FOR EQUIPMENT, QUALIFICATIONS, AND CALIBRATION shall be the primary standard.

3.3.2 Inspection of Repairs

All repairs shall undergo the same inspection procedure that originally revealed the discontinuities. Before acceptance, the welds shall meet the standards required for the original weld.

3.4 ACCEPTANCE/REJECTION LIMITS

Welds shall be accepted or rejected by ultrasonic indication in accordance with the following:

3.4.1 Full Penetration Butt Joints and Corner Joints

3.4.1.3 Class III

Welds shall be rejected on the basis of the following:

- a. Any discontinuity with a reflection exceeding the established reject/repair line and with a length exceeding 13 mm. Adjacent discontinuities separated by sound metal with a dimension less than twice the length of the longest discontinuity shall be considered a single discontinuity.
- b. Any discontinuity with a reflection greater than or equal to 50 percent of the reject/repair line, or with the level 8 dB more than the reject/repair line, and with a length (L) exceeding 50 mm or LT, whichever is greater.
- c. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds 75 mm or 2 T, whichever is greater, that weld length shall be rejected.

3.4.2 Full Penetration Tee Joints

Full Penetration Tee Joints (for Incomplete Root Penetration): Any discontinuity with the reflection exceeding the established reject/repair line of the applicable class shall be rejected. Any discontinuity with a reflection exceeding 25 percent of the established reject/repair line,

up to and including the reject/repair line, shall be rejected if its length exceeds $1/2 T$ in a direction transverse to the axis of the weld or LT parallel to the axis for all classes. If the total cumulative length of discontinuities in any 300 mm of weld length exceeds the limits of the applicable class, that weld length shall be rejected.

3.4.3 Partial and Full Penetration Tee Joints

Partial and Full Penetration Tee Joint Boundaries: The depth of weld penetration and weld cross section width at the through member surface shall be as indicated by applicable plans or drawings. Limits of discontinuities shall be as specified in preceding paragraphs.

3.4.4 Tee Joint Discontinuities

Tee joint discontinuities extending into the through member shall be rejected if reflection exceeds the established reject/repair line.

END OF SECTION

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SECTION 05120
STRUCTURAL STEEL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC FCD	(1995a) Quality Certification Program Description
AISC ASD Manual	(1989) Manual of Steel Construction Allowable Stress Design
AISC ASD/LRFD Vol II	(1992) Manual of Steel Construction Vol II: Connections
AISC Design Guide No. 10	(1989) Erection Bracing of Low-Rise Structural Steel Frames
AISC LRFD Vol I	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol I: Structural Members, Specifications & Codes
AISC LRFD Vol II	(1995) Manual of Steel Construction Load & Resistance Factor Design, Vol II: Structural Members, Specifications & Codes
AISC Pub No. S303	(1992) Code of Standard Practice for Steel Buildings and Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 6/A 6M	(1998a) General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 242/A 242M	(1998) High-Strength Low-Alloy Structural Steel
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength

ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 490	(1997) Heat-Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
ASTM A 490M	(1993) High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 501	(1999) Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A 514/A 514M	(1994a) High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A 529/A 529M	(1996) High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 563M	(1997) Carbon and Alloy Steel Nuts (Metric)
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 588/A 588M	(1997) High-Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick
ASTM A 618	(1999) Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A 709/A 709M	(1997a) Carbon and High-Strength Low-Alloy Structural Steel Shapes, Plates, and Bars and Quenched-and-Tempered Alloy Structural Steel Plates for Bridges
ASTM A 852/A 852M	(1997) Quenched and Tempered Low-Alloy Structural Steel Plate with 70 ksi (485 MPa) Minimum Yield Strength to 4 in. (100 mm) Thick
ASTM A 913/A 913M	(2000) High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)

ASTM A 992/A 992M	(1998e1) Steel for Structural Shapes For Use in Building Framing
ASTM F 436	(1993) Hardened Steel Washers
ASTM F 436M	(1993) Hardened Steel Washers (Metric)
ASTM F 844	(1998) Washers, Steel, Plain (Flat), Unhardened for General Use
ASTM F 959	(1999) Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners
ASTM F 1554	(1999) Standard Specification for Anchor Bolts, Steel, 36, 55 and 105-ksi Yield Strength

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B18.21.1	(1994) Lock Washers (Inch Series)
ASME B46.1	(1995) Surface Texture (Surface Roughness, Waviness, and Lay)

AMERICAN WELDING SOCIETY (AWS)

AWS A2.4	(1998) Standard Symbols for Welding, Brazing and Nondestructive Examination
AWS D1.1	(1998) Structural Welding Code - Steel

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 25	(1991) Red Iron Oxide, Zinc Oxide, Raw Linseed Oil and Alkyd Primer (without Lead and Chromate Pigments)
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1.2 GENERAL REQUIREMENTS

Structural steel fabrication and erection shall be performed by an organization experienced in structural steel work of equivalent magnitude. The Contractor shall be responsible for correctness of detailing, fabrication, and for the correct fitting of structural members. Connections, for any part of the structure not shown on the contract drawings, shall be considered simple shear connections and shall be designed and detailed in accordance with pertinent provisions of AISC ASD Manual and AISC LRFD Vol II. Substitution of sections or modification of connection details will not be accepted unless approved by the Contracting Officer. AISC LRFD Vol I and AISC LRFD Vol II shall govern the work. Welding shall be in accordance with AWS D1.1; except that welding for critical applications shall be in accordance with Section 05090 WELDING, STRUCTURAL or paragraph WELDING. High-strength bolting shall be in accordance with AISC LRFD Vol I.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Structural Steel System; G. Structural Connections; G

Shop and erection details, sizes and lengths, location; type & size of bolts; welds, connection details with blocks, copes & cuts including members (with their connections) not shown on the contract drawings. Welds shall be indicated by standard welding symbols in accordance with AWS A2.4. Submit fabrication drawings for approval prior to fabrication. Drawings shall not be reproductions of contract drawings. The applicable erection drawings shall always accompany detail cut sheets for all detail cut sheet submittals.

SD-03 Product Data

Erection; G
Survey; G

Prior to erection, erection plan of the structural steel framing describing all necessary temporary supports, including the sequence of installation and removal. Structural steel frame erection and location survey results per paragraph 3.2.2.1.

Welding; G

WPS not prequalified.

WPS prequalified.

SD-04 Samples

High Strength Bolts and Nuts; FIO
Carbon Steel Bolts and Nuts; FIO
Nuts Dimensional Style; FIO
Washers; FIO

Random samples of bolts, nuts, and washers as delivered to the job site if requested, taken in the presence of the Contracting Officer and provided to the Contracting Officer for testing to establish compliance with specified requirements.

SD-07 Certificates

Mill Test Reports; FIO

Certified copies of mill test reports for structural steel, structural bolts, nuts, washers and other related structural steel items, including attesting that the

structural steel furnished contains no less than 25 percent recycled scrap steel and meets the requirements specified, prior to the installation.

Welder Qualifications; G

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.1.

Welding Inspector; G

Welding Inspector qualifications.

Fabrication; G

A copy of the AISC certificate indicating that the fabrication plant meets the specified structural steelwork category.

1.4 STORAGE

Material shall be stored out of contact with the ground in such manner and location as will minimize deterioration.

1.5 WELDING INSPECTOR

Welding Inspector qualifications shall be in accordance with AWS D1.1

PART 2 PRODUCTS

2.1 STRUCTURAL STEEL

2.1.1 Carbon Grade Steel

Carbon grade steel shall conform to ASTM A 529/A 529M as noted on the contract drawings. For battalion and company operations, carbon grade steel shall be ASTM A36M.

2.1.2 High-Strength Low-Alloy Steel

High-strength low-alloy steel shall conform to ASTM A 913/A 913M, Grade 450 MPa.

2.1.7 Structural Shapes for Use in Building Framing

Wide flange shapes in accordance with ASTM A 992/A 992M shall be used where indicated on the drawings.

2.2 STRUCTURAL TUBING

Structural tubing shall conform to ASTM A 500, Grade B.

2.3 STEEL PIPE

Steel pipe shall conform to ASTM A 53, Type S, Grade B.

2.5 HIGH STRENGTH BOLTS AND NUTS

High strength bolts shall conform to ASTM A 325M Type 1 with carbon steel nuts conforming to ASTM A 563M, Grade C or ASTM A 325M, Type 3 with carbon steel nuts conforming to ASTM A 563M, Grade C3. The bolt heads and the nuts of the supplied fasteners must be marked with the manufacturers identification mark, strength grade and type specified. Provide washers in accordance with the AISC specification. For battalion and company operations, high strength bolts shall be ASTM F-1852M or ASTM-A325M.

2.6 CARBON STEEL BOLTS AND NUTS

Carbon steel bolts shall conform to ASTM A 307, Grade A with carbon steel nuts conforming to ASTM A 563M, Grade A.

2.6.1 ANCHOR BOLTS AND NUTS

Anchor bolts for moment frame columns shall conform to ASTM F 1554, Grade 380 MPa with carbon steel nuts conforming to ASTM A 563, Grade A.

Anchor bolts for other columns shall conform to A 307, Grade A with carbon steel nut conforming to ASTM A 563M, Grade A unless noted otherwise on the drawings.

A. For battalion and company operations, all anchor bolts shall conform to ASTM F1554 Grade 380 MPa with weld supplement SI, heavy hex nut, and ASTM F436 washer.

2.7 NUTS DIMENSIONAL STYLE

Carbon steel nuts shall be Hex style when used with ASTM A 307 bolts or Heavy Hex style when used with ASTM A 325M bolts.

2.8 WASHERS

Plain washers shall conform to ASTM F 844. Other types, when required, shall conform to ASTM F 436M. For battalion and company operations, all washers shall conform to ASTM F436M.

2.9 PAINT

Paint shall conform to SSPC Paint 25.

PART 3 EXECUTION

3.1 FABRICATION

Fabrication shall be in accordance with the applicable provisions of AISC ASD Manual. Fabrication and assembly shall be done in the shop to the greatest extent possible. The fabricating plant shall be certified under the AISC FCD for Category I structural steelwork. Compression joints depending on contact bearing shall have a surface roughness not in excess of 13 micrometer 500 micro inches as determined by ASME B46.1, and ends shall be square within the tolerances for milled ends specified in ASTM A 6/A 6M. Structural

steelwork, except surfaces of steel to be encased in concrete, surfaces to be field welded, surfaces to be fireproofed, and contact surfaces of friction-type high-strength bolted connections shall be prepared for painting in accordance with endorsement "P" of AISC FCD and primed with the specified paint.

3.2 ERECTION

- a: Erection of structural steel, except as indicated in item b. below, shall be in accordance with the applicable provisions of AISC ASD Manual. Erection plan shall be reviewed, stamped and sealed by a structural engineer retained by the erector and licensed by the state in which the project is located.
- b. For low-rise structural steel buildings (18 m tall or less and a maximum of 2 stories), the erection plan shall conform to AISC Pub No. S303 and the structure shall be erected in accordance with AISC Design Guide No. 10.

3.2.1 Structural Connections

Anchor bolts and other connections between the structural steel and foundations shall be provided and shall be properly located and built into connecting work. Do not overtighten anchor bolts set in concrete with impact wrenches. Field welded structural connections shall be completed before load is applied. Tighten high strength bolts as indicated on drawings. Bolts, nuts and washers shall be clean of dirt and rust and lubricated immediately prior to installation.

3.2.2 Base Plates and Bearing Plates

Column base plates for columns and bearing plates for beams, girders, and similar members shall be provided. Base plates and bearing plates shall be provided with full bearing after the supported members have been plumbed and properly positioned, but prior to placing superimposed loads. Separate setting plates under column base plates will not be permitted. The area under the plate shall be damp-packed solidly with bedding mortar, except where nonshrink grout is indicated on the drawings. Bedding mortar and grout shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.2.2.1 Structural Steel Frame Erection and Location

The contractor shall retain an independent land surveyor registered in the State of Washington to survey and certify that:

- a. All steel frame base plate anchor bolt locations have been accurately located within the tolerance limitations set by A.I.S.C.
- b. The steel frame columns have been erected vertically plumb, within the tolerance limitations set by A.I.S.C., prior to and subsequent to final bolting and welding.

Results of survey shall be recorded, sealed and signed by surveyor registered in the State of Washington. One copy shall be submitted to the Contracting Officer.

3.2.3 Field Priming

After erection, the field bolt heads and nuts, field welds, and any abrasions in the shop coat shall be cleaned and primed with paint of the same quality as that used for the shop coat.

3.3 WELDING

The contractor shall develop and submit the Welding Procedure Specifications (WPS) for all welding, including welding done using prequalified procedures. Prequalified procedures may be submitted for information only; however, procedures that are not prequalified shall be submitted for approval. See Section 05090A for inspection of welded connections.

3.4 FIELD QUALITY CONTROL

Perform field tests, and provide labor, equipment and incidentals required for testing. The Contracting Officer shall be notified in writing of defective welds, bolts, nuts, washers, headed studs and welded deformed bars within 7 working days of the date of weld inspection.

3.4.1 Welded Connection

For inspection of welded connections see Section 05090, WELDING, STRUCTURAL.

3.4.2 Load Indicator Washers

3.4.2.1 Load Indicator Washer Compression

Load indicator washers shall be tested in place to verify that they have been compressed sufficiently to provide the 0.015-inch gap when the load indicator washer is placed under the bolt head and the nut is tightened, and to provide the 0.005-inch gap when the load indicator washer is placed under the turned element, as required by ASTM F 959.

3.4.2.2 Load Indicator Gaps

In addition to the above testing, an independent testing agency as approved by the Contracting Officer, shall test in place the load indicator gaps on 20 percent of the installed load indicator washers to verify that the ASTM F 959 load indicator gaps have been achieved. If more than 10 percent of the load indicators tested have not been compressed sufficiently to provide the average gaps required by ASTM F 959, then all in place load indicator washers shall be tested to verify that the ASTM F 959 load indicator gaps have been achieved. Test locations shall be selected by the Contracting Officer.

3.4.3 High-Strength Bolts

3.4.3.1 testing Bolt, Nut and Washer Assemblies

Test a minimum of 3 bolt, nut, and washer assemblies from each mill certificate batch in a tension measuring device at the job site prior to the beginning of bolting start-up. Demonstrate that the bolts and nuts, when used together, can develop tension not less than the provisions specified in AISC S329 for all structural steel. The bolt tension shall be developed by tightening the nut. A representative of the manufacturer or supplier shall be

present to ensure that the fasteners are properly used, and to demonstrate that the fastener assemblies supplied satisfy the specified requirements.

3.4.3.2 Testing

The Government has the option to perform nondestructive tests on 5 percent of the installed bolts to verify compliance with pre-load bolt tension requirements. The nondestructive testing will be done in-place using an ultrasonic measuring device or any other device capable of determining in-place pre-load bolt tension. The test locations shall be selected by the Contracting Officer. If more than 10 percent of the bolts tested contain defects identified by testing, then all bolts used from the batch from which the tested bolts were taken, shall be tested. Retest new bolts after installation.

3.4.4 Erection Aides

The erector shall be solely responsible for reviewing and approving erection aides for the project. The erector shall remove all erection aides after completing erection unless the erection aide does not interfere with the architecture or the work of any trade.

END OF SECTION

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SECTION 05210

STEEL JOISTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

STEEL JOIST INSTITUTE (SJI)

SJI Specs & Tables	(1994) Standard Specifications Load Tables and Weight Tables for Steel Joists and Joist Girders
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Steel Joists; G

Detail drawings shall include fabrication and erection details, specifications for shop painting, and identification markings of joists.

SD-07 Certificates

Steel Joists

Certificates stating that the steel joists and joist girders have been designed and manufactured in accordance with SJI Specs & Tables. Complete engineering design computations may be submitted in lieu of the certification.

1.3 DESCRIPTION

Steel joists are designated on the drawings in accordance with the standard designations of the Steel Joist Institute. Joists of other standard designations or joists with properties other than those shown may be substituted for the joists designated provided the structural properties are equal to or greater than those of the joists shown and provided all other specified requirements are met.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition and stored off the ground in a well drained location, protected from damage, and easily accessible for inspection and handling.

1.5 QUALITY ASSURANCE

1.5.1 Member Design

Design, fabrication and erection shall be in accordance with the latest edition of "Standard Specification for Open Web Steel Joists" as adopted by the Steel Joist Institute. The fabricator shall be a member of the steel joist institute. A Steel Joist Institute letter or notarized affidavit stating current membership status in Steel Joist Institute shall accompany the shop drawing submittal. Steel joists shall be designed for loadings shown and noted on structural drawing schedules, plans and details and coordinated with mech/elec/plumbing drawings. All concentrated loads applied to joists including mechanical equipment shall be located at panel points where possible or as shown on drawings. Where it is necessary to apply concentrated loads between panel points, special provisions shall be made such as providing additional web members capable of supporting the load from point of load to panel point at opposite chord. Design of joists shall be supervised by a qualified Professional Engineer retained by the joist manufacturer. Shop drawings shall be submitted bearing the stamp of this Professional Engineer to certify that the joists have been designed and manufactured to carry the specified design loads in accordance with the SJI and AISC specifications. Joist manufacturer shall verify and include any fire rating stress reductions and size limitations in order to conform with the assembly requirements indicated on the contract drawings.

PART 2 PRODUCTS

2.1 OPEN WEB STEEL JOISTS

Open web steel joists shall conform to SJI Specs & Tables, K-Series. Joists shall be designed to support the loads given in the standard load tables of SJI Specs & Tables.

2.2 LONGSPAN STEEL JOISTS

Longspan steel joists shall conform to SJI Specs & Tables, LH-Series. Joists designated LH shall be designed to support the loads given in the applicable standard load tables of SJI Specs & Tables.

2.3 ACCESSORIES AND FITTINGS

Accessories and fittings, including end supports and bridging, shall be in accordance with the standard specifications under which the members were designed.

2.4 SHOP PAINTING

Joists and accessories shall be shop painted with a rust-inhibiting primer paint. For joists which will be finish painted under Section 09900 PAINTING, GENERAL, the primer paint shall be limited to a primer which is compatible with the specified finish paint.

PART 3 EXECUTION

3.1 ERECTION

The erection of steel joists shall conform to the requirements of the OSHA Steel Erection Standard, 29 CFR Part 1926, Subpart R- Steel Erection, Effective Date January 18, 2002. This standard may be obtained from the OSHA web site at <http://www.osha.gov>. Joists shall be handled in a manner to avoid damage. Damaged joists shall be removed from the site, except when field repair is approved and such repairs are satisfactorily made in accordance with the manufacturer's recommendations. Joists shall be accurately set, and end anchorage shall be in accordance with the standard specification under which the joists were produced. For spans over 12 m through 18 m one row of bridging nearest midspan shall be bolted diagonal bridging; for spans over 18 m bolted diagonal bridging shall be used instead of welded horizontal bridging. Joist bridging and anchoring shall be secured in place prior to the application of any construction loads. Any temporary loads shall be distributed so that the carrying capacity of any joist is not exceeded. Loads shall not be applied to bridging during construction or in the completed work. Abraded, corroded, and field welded areas shall be cleaned and touched up with the same type of paint used in the shop painting. Joist bearing shall be as shown and noted on the structural details with minimum bearing lengths per Steel Joist Institute. Special joist shoes shall be provided on all joists with a length of bearing less than Steel Joist Institute specification minimums. The manufacturer shall provide calculations for these special joist bearings. All steel joists shall have full contact bearing area under the joist shoes. Where this does not occur shims shall be provided by the fabricator as required to obtain full contact bearing over the entire shoe length. Bridging and other accessory details shall be per Steel Joist Institute and manufacturer requirements unless otherwise detailed on the drawings.

3.2 VISUAL INSPECTIONS

3.2.1 Pry Test

Before erection, visually inspect all joists at the site. Check any doubtful welds with a pry bar. If the weld cracks or breaks, replace the joist.

3.2.2 Erection Inspection

AWS D1.1, Section 6. Perform erection inspection and field welding inspections with AWS certified welding inspectors. Welding inspectors shall visually inspect and mark welds.

END OF SECTION

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SECTION 05300

STEEL DECKING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC)

AISC ASD Spec	(1989) Specification for Structural Steel Buildings - Allowable Stress Design and Plastic Design
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AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Mnl	(1996) Cold-Formed Steel Design Manual
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 108	(1995) Steel Bars, Carbon, Cold Finished, Standard Quality
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ASTM A 570/A 570M	(1996) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality
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ASTM A 611	(1997) Structural Steel (SS), Sheet, Carbon, Cold-Rolled
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ASTM A 653/A 653M	(1997) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
-------------------	--

ASTM A 780	(1993a) Repair of Damaged and Uncoated Areas of Hot-Dipped Galvanized Coatings
------------	--

ASTM A 792/A 792M	(1997) Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
-------------------	---

ASTM C 423	(1990a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
------------	---

ASTM E 795	(1993) Mounting Test Specimens During Sound Absorption Tests
------------	--

AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(1998) Structural Welding Code - Steel
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AWS D1.3 (1998) Structural Welding Code - Sheet Steel

STEEL DECK INSTITUTE (SDI)

SDI Diaphragm Mnl (1987; Amended 1991) Diaphragm Design Manual

SDI Pub No 29 (1995) Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution

STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Paint 20 (1991) Zinc-Rich Primers (Type I - Inorganic and Type II - Organic)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Deck Units; G
Accessories
Attachments
Holes and Openings

Drawings shall include type, configuration, structural properties, location, and necessary details of deck units, accessories, and supporting members; size and location of holes to be cut and reinforcement to be provided; location and sequence of welded connections; and the manufacturer's erection instructions.

SD-03 Product Data

Deck Units

Design computations for the structural properties of the deck units or SDI certification that the units are designed in accordance with SDI specifications.

Attachments

Prior to welding operations, copies of qualified procedures and lists of names and identification symbols of qualified welders and welding operators.

SD-04 Samples

Deck Units
Accessories

A 0.19 sq. meter sample of the decking material to be used, along with a sample of each of the accessories used. A sample of acoustical material to be used shall be included.

SD-07 Certificates

Deck Units
Attachments

Manufacturer's certificates attesting that the decking material meets the specified requirements. Manufacturer's certificate attesting that the operators are authorized to use the low-velocity piston tool.

1.3 DELIVERY, STORAGE, AND HANDLING

Deck units shall be delivered to the site in a dry and undamaged condition, stored off the ground with one end elevated, and stored under a weathertight covering permitting good air circulation. Finish of deck units shall be maintained at all times by using touch-up paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 DECK UNITS

Deck units shall conform to SDI Pub No 29. Panels of maximum possible lengths shall be used to minimize end laps. Deck units shall be fabricated in lengths to span 3 or more supports with flush, telescoped, or nested 50 mm laps at ends, and interlocking, or nested side laps, unless otherwise indicated. Deck with cross-sectional configuration differing from the units indicated may be used, provided that the properties of the proposed units, determined in accordance with AISI Cold-Formed Mnl, are equal to or greater than the properties of the units indicated and that the material will fit the space provided without requiring revisions to adjacent materials or systems.

2.1.1 Roof Deck

Steel deck used in conjunction with insulation and built-up roofing shall conform to ASTM A 653/A 653M, ASTM A 611 or ASTM A 792/A 792M. Roof deck units shall be fabricated of the steel design thickness required by the design drawings and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class or aluminum-zinc coated in accordance with ASTM A 792/A 792M Coating Designation AZ55.

2.1.2 Composite Deck

Deck to receive concrete as a filler or for composite deck assembly shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as the tension reinforcing in composite deck shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class. Deck units used in composite deck shall have adequate embossment to develop mechanical shear bond to provide composite action between the deck and the concrete.

2.1.3 Form Deck

Deck used as a permanent form for concrete shall conform to ASTM A 653/A 653M or ASTM A 611. Deck used as a form for concrete shall be fabricated of the steel design thickness required by the design drawings, and shall be zinc-coated in conformance with ASTM A 653/A 653M, G90 coating class.

2.1.4 Shear Connectors

Shear connectors shall be headed stud type, ASTM A 108, Grade 1015 or 1020, cold finished carbon steel with dimensions complying with AISC ASD Spec.

2.2 TOUCH-UP PAINT

Touch-up paint for zinc-coated units shall be an approved galvanizing repair paint with a high-zinc dust content. Welds shall be touched-up with paint conforming to SSPC Paint 20 in accordance with ASTM A 780. Finish of deck units and accessories shall be maintained by using touch-up paint to repair damaged deck coating to prevent the formation of rust, except for surfaces to be covered with concrete topping.

2.3 ADJUSTING PLATES

Adjusting plates or segments of deck units shall be provided in locations too narrow to accommodate full-size units. As far as practical, the plates shall be the same thickness and configuration as the deck units.

2.4 CLOSURE PLATES

2.4.1 Closure Plates for Roof Deck

Voids above interior walls shall be closed with sheet metal where shown. Open deck cells at parapets, end walls, eaves, and openings through roofs shall be closed with sheet metal. Sheet metal shall be same thickness as deck units.

2.4.2 Closure Plates for Composite Deck

The concrete shall be supported and retained at each floor level. Provide edge closures at all edges of the slab of sufficient strength and stiffness to support the wet concrete. Metal closures shall be provided for all openings in composite steel deck 6 mm and over, including but not limited to:

2.4.2.1 Cover Plates to Close Panels

Cover plates to close panel edge and end conditions and where panels change direction or abut. Butt joints in composite steel deck may receive a tape joint cover.

2.4.2.2 Column Closures to Close Openings

Column closures to close openings between steel deck and structural steel columns.

2.4.2.3 Sheet Metal

Where deck is cut for passage of pipes, ducts, columns, etc., and deck is to remain exposed, provide a neatly cut sheet metal collar to cover edges of deck. Do not cut deck until after installation of supplemental supports.

2.5 ACCESSORIES

The manufacturer's standard accessories shall be furnished as necessary to complete the deck installation. Metal accessories shall be of the same material as the deck and have minimum design thickness as follows: saddles, 1.204 mm; welding washers, 1.519 mm; cant strip, 0.749 mm; other metal accessories, 0.909 mm ; unless otherwise indicated.

Accessories shall include but not be limited to saddles, welding washers, cant strips, butt cover plates, underlapping sleeves, and ridge and valley plates.

PART 3 EXECUTION

3.1 ERECTION

The steel erection shall conform to the requirements of the OSHA Steel Erection Standard, 29 CFR Part 1926, Subpart R- Steel Erection, Effective Date January 18, 2002. This standard may be obtained from the OSHA web site at <http://www.osha.gov>. Erection of deck and accessories shall be in accordance with SDI Pub No 29, SDI Diaphragm Manual and the approved detail drawings. Damaged deck and accessories including material which is permanently stained or contaminated, with burned holes or deformed shall not be installed. The deck units shall be placed on secure supports, properly adjusted, and aligned at right angles to supports before being permanently secured in place. The deck shall not be filled with concrete, used for storage or as a working platform until the units have been secured in position. Shoring, if required, shall be in position before concrete placement begins in composite or form deck. Loads shall be distributed by appropriate means to prevent damage during construction and to the completed assembly. The maximum uniform distributed storage load shall not exceed the design live load. There shall be no loads suspended directly from the steel deck.

3.2 ATTACHMENTS

All fasteners shall be installed in accordance with the manufacturer's recommended procedure, except as otherwise specified. The deck units shall be welded with nominal 16 mm diameter puddle welds to supports as indicated on the design drawings and in accordance with requirements of SDI Pub No 29. All welding of steel deck shall be in accordance with AWS D1.3 using methods and electrodes as recommended by the manufacturer of the steel deck being used. Welds shall be made only by operators previously qualified by tests prescribed in AWS D1.3 to perform the type of work required. Welding washers shall not be used at the connections of the deck to supports. Welding washers shall not be used at sidelaps. Holes and similar defects will not be acceptable. Deck ends shall be lapped 50 mm. All partial or segments of deck units shall be attached to structural supports in accordance with Section 2.5 of SDI Diaphragm Mnl. Immediately recertify, or replace with qualified welders, those welders who have passed qualification tests but are producing unsatisfactory welding.

3.3 HOLES AND OPENINGS

All holes and openings required shall be coordinated with the drawings, specifications, and other trades. Holes and openings shall be drilled or cut, reinforced and framed as indicated on the drawings or described in the specifications and as required for rigidity and load capacity. Holes and openings less than 150 mm across require no reinforcement. Holes and openings 150 to 300 mm across shall be reinforced by 1.204 mm thick steel sheet at least 300 mm wider and longer than the opening and be fastened to the steel deck at each corner of the sheet and at a maximum of 150 mm on center. Holes and openings larger than 300 mm shall be reinforced by steel angles installed perpendicular to the steel joists and supported by the adjacent steel joists. The deck manufacturer and Contracting Officer shall approve holes or openings larger than 300 mm prior to drilling or cutting. Steel angles shall be installed perpendicular to the deck ribs and shall be fastened to the angles perpendicular to the steel joists. Openings must not interfere with seismic members such as chords and drag struts.

3.4 PREPARATION OF FIRE-PROOFED SURFACES

Deck surfaces, both composite and noncomposite, which are to receive sprayed-on fireproofing, shall be galvanized and shall be free of all grease, mill oil, paraffin, dirt, salt, and other contaminants which impair adhesion of the fireproofing. Any required cleaning shall be done prior to steel deck installation using a cleaning method that is compatible with the sprayed-on fireproofing.

3.5 HANGERS

Provide clips or loops for suspended ceilings where slots or holes are punched in decking for installation of pigtails or decking manufacturer's standard connection as approved by the Contracting Officer. All connections must be to the concrete not to the metal deck itself.

END OF SECTION

SECTION 05400

COLD-FORMED STEEL FRAMING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN IRON AND STEEL INSTITUTE (AISI)

AISI Cold-Formed Spec	(1996) Specification & Commentary for the Design of Cold-Formed Steel Structural Members (Part V of the Cold-Formed Steel Design Manual)
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 123/A 123M	(1997ae1) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 370	(1997a) Mechanical Testing of Steel Products
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 633	(1985; R 1998) Electrodeposited Coatings of Zinc on Iron and Steel
ASTM C 955	(1998) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM C 1007	(1998e1) Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories
ASTM E 329	(1998) Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction

AMERICAN WELDING SOCIETY (AWS)

AWS D1.3	(1998) Structural Welding Code - Sheet Steel
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SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 78

(1998) Steel Self Drilling Tapping Screws

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Manufacturer's technical literature covering products; G

- a. Section properties and installation instructions

SD-02 Shop Drawings

Framing Components; G

- a. Cross sections, plans, and/or elevations showing component types and locations for each framing application; including shop coatings and material thicknesses for each framing component.
- b. Connection details showing fastener type, quantity, location, and other information to assure proper installation.
- c. Drawings depicting panel configuration, dimensions, components, locations, and construction sequence if the Contractor elects to install prefabricated/prefinished frames.

SD-07 Certificates

Mill Certificates; FIO

Mill certificates or test reports from independent testing agency, qualified in accordance with ASTM E 329, showing that the steel sheet used in the manufacture of each cold-formed component complies with the minimum yield strengths and uncoated steel thickness specified. Test reports shall be based on the results of three coupon tests in accordance with ASTM A 370.

Welds; FIO

Certified copies of welder qualifications test records showing qualification in accordance with AWS D1.3.

1.3 DELIVERY, HANDLING AND STORAGE

Materials shall be delivered and handled preventing bending or other damage, and avoiding contact with soil or other contaminating materials. Finish of the framing members shall be

maintained at all times, using an approved high zinc dust content, galvanizing repair paint whenever necessary to prevent the formation of rust.

PART 2 PRODUCTS

2.1 STEEL STUDS, TRACKS, BRACING, BRIDGING, AND ACCESSORIES

Framing components shall comply with ASTM C 955 and the following:

- a. Material shall be corrosion-resistant steel complying with ASTM A 653M, having the following minimum yield strengths and a G 60 minimum zinc coating:

- (1) Studs, Tracks and accessories- $F_y = 230 \text{ Mpa}$
- (2) Rafters- $F_y = 345 \text{ Mpa}$

- b. Minimum design thickness:

- (1). Studs and Tracks: 1.15mm UNO on drawings.
- (2). Joists: Thickness as shown on the drawings.
- (3). Bracing and bridging: Thickness as shown on the drawings.
- (4). Accessories: Standard thickness as provided by the manufacturer.

- c. Stud and Track web depth: 150 mm

- d. Stud flange width: 51mm UNO on drawings.

- e. Stud effective section properties UNO on drawings:

- (1). $S_x = 14300 \text{ mm}^3$
- (2). $I_x = 1117000 \text{ mm}^4$

- f. Joist effective section properties as shown on the drawings.

2.2 MARKINGS

Studs and track shall have product markings on the web of the section. The markings shall be repeated throughout the length of the member at a maximum spacing of 1200 mm on center and shall be legible and easily read. The product marking shall include the following:

- a. Manufacturer's identification.
- b. Minimum delivered uncoated steel thickness.
- c. Protective coating designator.
- d. Minimum yield strength.

2.3 CONNECTIONS

Screws for steel-to-steel connections shall be self-drilling tapping in compliance with SAE J 78 of the type, size, and location as shown on the drawings. Electroplated screws shall have a Type II coating in accordance with ASTM B 633. Screws, bolts, and anchors shall be hot-dipped galvanized in accordance with ASTM A 123/A 123M or ASTM A 153/A 153M as appropriate.

PART 3 EXECUTION

3.1 DELIVERY, HANDLING AND STORAGE

- a. Materials shall be delivered and handled in a manner to avoid bending or other damage and to avoid contact with the soil or other contaminating materials.
- b. Finish of the framing members shall be maintained at all times, using an approved high zinc dust content galvanizing repair paint whenever necessary to prevent the formation of rust.

3.2 CONNECTIONS

3.2.1 Welds

All welding shall be performed in accordance with AWS D1.3, as modified by AISI Cold-Formed Spec. All welders, welding operations, and welding procedures shall be qualified according to AWS D1.3. All welds shall be cleaned and coated with rust inhibitive galvanizing paint.

3.2.2 Screws

Screws shall be self-drilling self-tapping type, size, and location shown on the drawings. Screw penetration through joined materials shall not be less than three exposed threads. Minimum spacings and edge distances for screws shall be as specified in AISI Cold-Formed Spec. Screws covered by sheathing materials shall have low profile heads.

3.2.3 Anchors

Anchors shall be of the type, size, and location shown on the drawings.

3.3 INSTALLATION

3.3.1 General Requirements

- a. Prefabricated frames shall be square, with components attached to prevent racking during fabrication, transportation, and lifting. Design and construction of frames shall include provisions for lifting.
- b. Cutting of steel framing shall be by saw, shear, or plasma cutting equipment. Oxyacetylene torch cutting is not permitted.

- c. Temporary bracing shall be provided and remain in place until work is permanently stabilized.
- d. Abutting lengths of track shall be butt-welded, spliced, or each length securely anchored to a common structural element. Track shall be securely anchored to the supporting structure as shown on the drawings.
- e. Splicing of framing components, other than track and tension members, is not permitted.
- f. Wire tying of framing members is not permitted.

3.3.2 Non-Load Bearing Walls (Curtain walls)

- a. Studs shall be spaced at 406 mm inches on center.
- b. Studs shall be plumbed, aligned, and secured to the continuous runner tracks at each end, unless the stud end terminates at a deflection track.
- c. Tracks shall be securely anchored to the supporting structure as shown on the drawings.
- d. Bridging spaced at 1220 mm shall be installed prior to the installation of facing materials.
- e. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings that are larger than the stud spacing in a wall.
- f. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings.
- g. Installation of sheathing, wallboards, or any other collateral material shall be performed in accordance with the product manufacturer's specifications.
- h. Components (Deflection Track and/or Slide Clips) shall be provided at locations shown on the drawings to accommodate potential movements of Primary Frames. Construction shall accommodate a vertical movement of 20 mm. inches.

3.3.3 Load Bearing Walls

3.3.3.1 Axial Load

Installation shall comply with ASTM C 1007 and the following:

- a. Studs shall be spaced at 600 mm UNO on drawings.

- b. Studs shall be installed seated squarely **and firmly** in the top and bottom track to assure transfer of axial load. Studs shall be plumbed, aligned, and secured to the continuous runner tracks at each end before the installation of components which induce axial load.
- c. Studs, other than at framed openings, shall align vertically to allow for full transfer of the loads to the foundation. Vertical alignment shall be maintained at floor/wall intersections.
- d. Foundation bearing bottom track shall rest on a continuous, uniform, and level bearing surface.
- e. Tracks shall be securely anchored to the supporting structure as shown on the drawings.
- f. Bridging spaced at 1200 mm shall be installed prior to loading and the installation of facing materials.
- g. Framed wall openings shall include headers and supporting components as shown on the drawings. Headers shall be installed in all openings which are larger than the stud spacing in a wall.
- h. At wall openings for doors, windows and other similar features, the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached through built-in anchors to the nearest stud on each side of the opening with self-drilling screws. Double studs shall be provided at both jambs of all door openings.
- i. Installation of sheathing, wallboards, or any other collateral material shall be performed in accordance with the product manufacturer's specifications.

3.3.3.2 Lateral Load (Shear Wall Panels)

Shear wall panels shall be installed at the locations shown; stud spacing and arrangement shall be as shown; diagonal bracing shall be placed across studs, pulled tight, and attached to each stud within the shear panel as shown on the drawings.

3.3.4 Joists

- a. Joists shall be spaced as shown on the drawings.
- b. Uniform and level joist bearing at the foundation wall shall be provided by means of shims and/or non-shrink grout.
- c. Web stiffeners at support locations and at points of concentrated loads shall be provided as shown on the drawings.
- d. Joists shall align vertically with load bearing studs.
- e. Bridging, of the type and spacing shown on the drawings, shall be installed prior to loading.

- f. Additional framing around openings shall be provided as shown on the drawings when the width of the opening exceeds the typical joist spacing.

3.4 TOLERANCES

Vertical alignment (plumbness) of studs shall be within 1/960th of the span. Horizontal alignment (levelness) of walls shall be within 1/960th of their respective lengths. Spacing of studs shall not be more than plus 3 mm from the designed spacing providing the cumulative error does not exceed the requirements of the finishing material.

END OF SECTION

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SECTION 05500

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A14.3 (1992) Ladders - Fixed - Safety Requirements

ANSI MH28.1 (1982) Design, Testing, Utilization, and Application of Industrial Grade Steel Shelving

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (2000) Carbon Structural Steel

ASTM A 53/A 53M (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

ASTM A 123/A 123M (2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 283/A 283M (2000) Low and Intermediate Tensile Strength Carbon Steel Plates

ASTM A 467/A 467M (1998) Machine and Coil Chain

ASTM A 475 (1998) Zinc-Coated Steel Wire Strand

ASTM A 500 (1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

ASTM A 653/A 653M (2000) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 26/B 26M (1999) Aluminum-Alloy Sand Castings

ASTM B 221	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(2000) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 429	(2000) Aluminum-Alloy Extruded Structural Pipe and Tube
ASTM D 2047	(1999) Static Coefficient of Friction of Polish-Coated Floor Surfaces as Measured by the James Machine
ASTM E 814	(2000) Fire Tests of Through-Penetration Fire Stops
ASTM F 1267	(1991; R 1997) Metal, Expanded, Steel

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1998) Minimum Design Loads for Buildings and Other Structures
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-344	(Rev B) Lacquer, Clear Gloss, Exterior, Interior
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NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM MBG 531	(1994) Metal Bar Grating Manual
NAAMM MBG 532	(1994) Heavy Duty Metal Bar Grating Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 10	(1998; Errata 10-98-1) Portable Fire Extinguishers
NFPA 211	(2000) Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Miscellaneous Metal Items; G.

Detail drawings indicating material thickness, type, grade, and class; dimensions; and construction details. Drawings shall include catalog cuts, erection details, manufacturer's descriptive data and installation instructions, and templates. Detail drawings for the following items: G

SD-04 Samples

Miscellaneous Metal Items; FIO.

Samples of the following items: access panels and doors. Samples shall be full size, taken from manufacturer's stock, and shall be complete as required for installation in the structure. Samples may be installed in the work, provided each sample is clearly identified and its location recorded.

1.3 GENERAL REQUIREMENTS

The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.4 DISSIMILAR MATERIALS

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.5 WORKMANSHIP

Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.6 ANCHORAGE

Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.7 ALUMINUM FINISHES

Unless otherwise specified, aluminum items shall have hand sanded or machine finish to a 240 grit. The thickness of the coating shall be not less than that specified for protective and decorative type finishes for items used in interior locations or architectural Class I type finish for items used in exterior locations in AA DAF-45. Items to be anodized shall receive a polished satin finish.

1.8 SHOP PAINTING

Surfaces of ferrous metal, except galvanized surfaces, shall be cleaned and shop coated with the manufacturer's standard protective coating unless otherwise specified. Surfaces of items to be embedded in concrete shall not be painted. Items to be finish painted shall be prepared according to manufacturer's recommendations or as specified.

PART 2 PRODUCTS

2.1 FLOOR DOORS, ACCESS DOORS AND REMOVABLE PANELS

2.1.1 Interior Wall and Ceiling Doors

Doors shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 1.52 mm (16 gauge) steel with welded joints and finished with anchorage for securing into construction. Frames located in drywall shall utilize drywall bead construction such that drywall finish covers frame and only door is visible. Access doors shall be sized as indicated. Where no size shown, doors shall be a minimum of 300 by 300 mm. Larger doors shall be provided where device being accessed requires more room. Door panel shall be not lighter than 1.9 mm (14 gauge) steel, with stiffened edges, complete with attachments. Access doors shall be hinged to frame with a concealed, continuous piano hinge with stainless steel pin. Doors shall be provided with a flush face, screwdriver operated latch when located in rooms that are normally locked to occupants (Mechanical, Electrical and Communication Rooms). At all other areas, doors shall be provided with a mortise lock matching lock and keying hardware as specified in SECTION: DOOR HARDWARE. Exposed metal surfaces (except lock cylinders) shall have a shop applied prime coat. Finish coat shall match adjacent wall. All access doors located in fire rated walls shall be rated by an independent testing laboratory to at least match the rating of the wall.

2.1.2 Exterior Wall and Ceiling Doors

Exterior access doors shall be flush type unless otherwise indicated. Frames for access doors shall be fabricated of not lighter than 2 mm thick extruded aluminum. Frames located in brick shall be mortared into the wall during brick placement. Access doors shall be sized as

indicated. Where no size shown, doors shall be a minimum of 300 by 300 mm or larger where device being accessed requires more room. Door panel shall be aluminum on all faces, and not lighter than 1.5 mm thick, with 2" thick fully contained fiberglass insulation. Access doors shall be hinged to frame with a concealed, continuous piano hinge with stainless steel pin. Doors shall be provided with a flush face, mortise lock matching lock and keying hardware as specified in SECTION: DOOR HARDWARE. Entire door perimeter shall be provided with a flexible gasket providing a complete air and water seal. Exposed metal surfaces (except lock cylinders) shall have a shop applied prime coat. Finish coat shall match adjacent surface.

2.1.3 Floor Doors

Fire rated floor doors shall be installed in the attic floor where indicated on drawings. Door opening size shall be 900 by 900 mm. Frame material shall be steel. Aluminum door shall have diamond pattern tread or abrasive coating on walking surface to improve slip resistance. Hinges, latch, springs and hold open arm shall all be Type 316 stainless steel. Latch shall be provided with inside lever handle and outside key handle. Lock and keying shall match hardware as specified in SECTION: DOOR HARDWARE. Springs shall be fully enclosed type and counterbalance the door to limit opening force to no more than 13 kg. Hold open shall lock the door at 90 degrees when opened and be releasable with single hand operation. Load capacity shall be at least 135 kg. Door assembly shall be designed and tested (U.L. or similar) to maintain 1-hour fire rating at attic floor. Paint all exposed surfaces to match ceiling adjacent.

2.1.4 "LadderUp" Safety Post

Ladders accessing attics through floor doors shall be equipped with a "LadderUp" Safety Post (Model LU-1) device as manufactured by The Bilco Company, New Haven CT. Post shall be fabricated of steel high strength square tubing. All hardware shall be Type 316 stainless steel. Post shall have manufacturer's standard finish.

2.1.5 Removable Ceiling Panels

Removable ceiling panels shall be provided in gypsum wallboard ceilings, as indicated. Panels shall be flush type unless otherwise indicated. Frames for removable panels shall be fabricated of not lighter than 1.52 mm (16 gauge) steel with welded joints and finished with anchorage for securing into construction. Frames located in drywall shall utilize drywall bead construction such that drywall finish covers frame and only panel is visible. Access doors shall be sized as indicated. Where no size shown, doors shall be a minimum of 300 by 300 mm. Provide 800 by 800 mm minimum panel size where maintenance personnel must stand inside the opening. Panel shall be not lighter than 1.9 mm (14 gauge) steel, with stiffened edges, complete with attachments. Panel shall be attached to frame with screws in each corner, or concealed, cam type latches. Provide retention clip or removable cable retainer to prevent panel from free falling when all attachment devices are released. Removable panels shall not be located in corridors or stairs. Exposed metal surfaces shall have a shop applied prime coat. Finish coat shall match adjacent surface.

2.2 CORNER GUARDS AND SHIELDS

Corner guards and shields for jambs and sills of openings and edges of platforms shall be steel shapes and plates anchored in masonry or concrete with welded steel straps or end

weld stud anchors. Corner guards for use with glazed or ceramic tile finish on walls shall be formed of 1.6 mm inch thick corrosion-resisting steel with polished or satin finish, shall extend 1.5 m above the top of cove base or to the top of the wainscot, whichever is less, and shall be securely anchored to the supporting wall. Corner guards on exterior shall be galvanized.

2.3 PIPE GUARDS

Pipe guards shall be heavy duty steel pipe conforming to ASTM A 53/A 53M, Type E or S, weight STD, black finish.

2.4 DOWNSPOUT BOOTS

Downspout boots shall be cast iron with receiving bells sized to fit downspouts.

2.5 EXPANSION JOINT COVERS (Not used)

2.6 FLOOR GRATINGS AND FRAMES

Stainless steel grating shall be designed in accordance with NAAMM MBG 531 to meet the indicated load requirements. Edges shall be banded with bars 6 mm less in height than bearing bars for grating sizes above 19 mm. Banding bars shall be flush with the top of bearing grating. Frames shall be of welded steel construction finished to match the grating. Floor gratings and frames shall be galvanized after fabrication.

2.7 FLOOR PLATES

Floor plates shall be 6 mm thick, slip-resistant, carbon steel conforming to ASTM A 283/A 283M having a minimum static coefficient of friction of 0.50 when tested in accordance with ASTM D 2047. Wearing surface shall be aluminum oxide or silicon carbide.

2.8 HANDRAILS AND GUARDRAILS

Handrails shall be designed to resist a concentrated load of 890 N (200 pounds) in any direction at any point of the top of the rail or 292 Newtons per meter (20 pounds per foot) applied horizontally to top of the rail, whichever is more severe.

2.8.1 Steel Handrails, Including Carbon Steel Inserts

Steel handrails shall be used only at interior locations not exposed to the weather. Steel handrails, including inserts in concrete, shall be steel pipe conforming to ASTM A 53/A 53M or structural tubing conforming to ASTM A 500, Grade A or B of equivalent strength. Steel railings shall be 40 mm nominal size. Railings shall be shop prime painted. Pipe collars shall be steel.

a. Joint posts, rail, and corners shall be fabricated by one of the following methods:

(1) Flush type rail fittings of commercial standard, welded and ground smooth with railing splice locks secured with 10 mm hexagonal recessed-head setscrews.

(2) Mitered and welded joints by fitting post to top rail and intermediate rail to post, mitering corners, groove welding joints, and grinding smooth. Railing splices shall

be butted and reinforced by a tight fitting interior sleeve not less than 150 mm inches long.

(3) Railings may be bent at corners in lieu of jointing, provided bends are made in suitable jigs and the pipe is not crushed.

b. Removable sections, toe-boards, and brackets shall be provided as indicated.

2.8.2 Aluminum Handrails

Aluminum handrails shall be used at all exterior locations. Handrails shall consist of 40 mm nominal Schedule 40 pipe ASTM B 429. Railings and pipe collars shall be anodized aluminum, color as indicated on drawings. All fasteners shall be Series 300 stainless steel.

a. Jointing shall be by one of the following methods:

(1) Flush type rail fittings, welded and ground smooth with splice locks secured with 10 mm recessed head set screws.

(2) Mitered and welded joints, made by fitting post to top rail and intermediate rail to post and corners, shall be groove welded and ground smooth. Splices, where allowed by the Contracting Officer, shall be butted and reinforced by a tight fitting dowel or sleeve not less than 150 mm in length. Dowel or sleeve shall be connected to one side of the splice by tack welding or by using epoxy cement.

(3) Railings shall be assembled using slip-on aluminum-magnesium alloy fittings for joints. Fittings shall be fastened to pipe or tube with 6 mm or 10 mm stainless steel recessed head setscrews. Assembled railings shall be provided with fittings only at vertical supports or at rail terminations attached to walls. Expansion joints shall be at the midpoint of panels. A setscrew shall be provided in only one side of the slip-on sleeve. Alloy fittings shall conform to ASTM B 26/B 26M.

b. Removable sections, toe-boards and brackets shall be provided where indicated, using flange castings as appropriate.

2.9 LADDERS

Ladders shall be galvanized steel or aluminum, fixed rail type in accordance with ANSI A14.3. Ladders located in stairs shall be painted to match stair guardrail color.

2.10 MIRROR FRAMES

See SECTION: TOILET ACCESSORIES.

2.11 MISCELLANEOUS

Miscellaneous plates and shapes for items that do not form a part of the structural steel framework, such as lintels, sill angles, miscellaneous mountings, and frames, shall be provided to complete the work.

2.12 PARTITIONS, DIAMOND MESH TYPE

Partitions shall be constructed of metal fabric attached to structural steel framing members. Fabric shall be expanded metal conforming to ASTM F 1267 of 38 mm, 1-1/2 inch, No. 9 diamond mesh secured to channel frame by welding. Framing members shall be channels 38 by 3 mm 1-1/2 by 1/8 inch minimum size. Channel frames shall be mortised and tenoned at intersections. Steel frames, posts, and intermediate members shall be of the sizes and shapes indicated. Cast-iron floor shoes and caps shall have setscrew adjustment. Doors and grilles shall be provided as indicated, complete with hardware and accessories including sliding mechanisms, locks, guard plates, sill shelves and brackets, and fixed pin butts. Doors and grilles shall have cover plates as indicated. Dutch doors shall have a lock for each leaf. A continuous rubber bumper shall be provided at bottom of grille frame. Locks shall be bronze, cylinder, mortise type. Keying shall be coordinated with SECTION 08710 DOOR HARDWARE. Ferrous metal portions of partitions and accessories shall be shop primed and painted. Coordinate with Section 09900 PAINTING, GENERAL.

2.13 SAFETY CHAINS

Safety chains shall be galvanized welded steel, proof coil chain tested in accordance with ASTM A 467/A 467M, Class CS. Safety chains shall be straight link style, 5 mm diameter, minimum 39 links per meter and with bolt type snap hooks on each end. Eye bolts for attachment of chains shall be galvanized 10 mm bolt with 19 mm eye, anchored as indicated. Two chains shall be furnished for each guarded opening.

2.14 SAFETY NOSING

Safety nosings shall be of cast aluminum with cross-hatched, abrasive surface. Nosing shall be 75 mm wide and terminating at not more than 150 mm from the ends of treads, except nosing for metal pan cement-filled treads shall extend the full length of the tread. Safety nosings shall be provided with anchors not less than 19 mm long. Integrally cast mushroom anchors are not acceptable.

2.15 UTILITY SHELVING

Shelving shall conform to ANSI MH28.1 and shall be open and capable of resisting a uniform load of 140 kg per meter. Minimum dimensions and number of shelves shall be as indicated.

2.16 STEEL STAIRS

Steel stairs shall be complete with structural or formed channel stringers, metal pan cement-filled treads, landings, columns, handrails, and necessary bolts and other fastenings as indicated. Structural steel shall conform to ASTM A 36/A 36M. Stairs and accessories shall be painted. Risers on stairs with metal pan treads shall be deformed to form a sanitary cove to retain the tread concrete. Integral nosings shall have braces extended into the concrete fill.

2.17 TRENCH COVERS, FRAMES, AND LINERS

Trench covers shall be designed to meet the indicated load requirements. Trench frames and anchors shall be all welded steel construction designed to match cover. Covers shall be secured to frame, and shall be steel floor plate. Grating opening widths shall not exceed 25 mm. Trench liners shall be cast iron with integral frame for cover.

2.18 FIRE EXTINGUISHER CABINETS

See SECTION: FIRE EXTINGUISHER CABINETS.

2.19 RECESSED ENTRANCE GRATING

Provide grate of Type 304 stainless steel of self-cleaning, I-beam type design and conforming to ASTM A 167. Grating primary members shall run perpendicular to the direction of foot traffic. Each juncture of the surface wires to their support shall have electric resistance welded joints. Provide recessed frames for entry grates of stainless steel, in sizes shown. Miter corners to ensure accurate fitting. Unit construction will be for loads of 100 pounds per square foot. Surface finish will be stainless steel satin. Recess depth shall be as indicated on drawings or by the mat or grate thickness. Anchor frames in concrete with anchor pins or bolts.

2.20 BOOT AND EQUIPMENT WASH, GRATING AND FRAMES

Trench frames and anchors shall be welded steel and galvanized G90 after fabrication. Grating and frame shall be as indicated.

2.21 ORNAMENTAL LOUVER GRILLE

Ornamental louver grille shall be hot dip galvanized after fabrication and as indicated in the drawings.

2.22 GATE FRAME

Gate frame shall be fabricated of 100 mm tube steel with a minimum 6 mm thickness. Frame shall have an interior brace concealed from exterior view. (Brace can be attached to backside of gate.) Hardware and attachments shall withstand a 500# vertical load on the end of the gate (side opposite hinges.) The louver infill shall conform to SECTION: SHEET METALWORK, GENERAL. Louver will be subject to moderate abuse, provide 16 GA minimum louver slat. Louver is intended only to screen views. Hot dip galvanize gate and louver after fabrication. See SECTION: DOOR HARDWARE for gate hardware.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

All items shall be installed at the locations shown and according to the manufacturer's recommendations. The steel erection shall conform to the requirements of the OSHA Steel Erection Standard, 29 CFR Part 1926, Subpart R- Steel Erection, Effective Date January 18, 2002. This standard may be obtained from the OSHA web site at <http://www.osha.gov>. Items listed below require additional procedures as specified.

3.2 ACCESS DOORS AND REMOVABLE PANELS

An access door or panel as indicated and not less than 300 by 300 mm in size, shall be installed directly below (or adjacent to at walls) each valve, flow indicator, damper, air splitter or similar mechanical, electrical or telecommunications component that is located above

gypsum wallboard ceilings or within walls. Anchor door/panel frames to underlying structure. Access doors or panels are not required at acoustical ceiling areas that are accessible by ceiling tile removal. Doors and panels shall be installed flush to the adjacent surface, plumb and square to adjacent edges and joints. Protect hinges and joints between door and frame from contamination by gypsum wallboard joint compound, paints and similar materials.

3.3 INSTALLATION OF PIPE GUARDS

Pipe guards shall be set vertically in concrete piers. Piers shall be constructed of, and the hollow cores of the pipe filled with, concrete specified in SECTION 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.4 INSTALLATION OF DOWNSPOUT BOOTS

Downspouts shall be secured to building through integral lips with appropriate fasteners. Top of downspout boot shall not extend more than 150 mm above grade.

3.5 ATTACHMENT OF HANDRAILS

Toeboards and brackets shall be installed where indicated. Splices, where required, shall be made at expansion joints. Removable sections shall be installed as indicated.

3.5.1 Installation of Steel Handrails

Installation shall be base plates bolted to stringers or structural steel framework. Rail ends shall be secured by steel pipe flanges through-bolted to a back plate.

3.5.2 Installation of Aluminum Handrails

Installation shall be by means of flanges anchored to concrete or masonry by expansion shields. Bolts used to anchor aluminum alloy flanges shall be stainless steel of a size appropriate to the standard product of the manufacturer. Where aluminum or alloy fittings or extrusions are to be in contact with dissimilar metals or portland cement concrete, the contact surface shall be given a heavy coating of bituminous paint or asphalt varnish.

3.6 PARTITION POSTS AND OPENINGS

Posts shall be set in shoes bolted to the floor and in caps tap-screwed to clip angles in overhead construction, as indicated. Openings shall be formed using channels similar to the partition frames at ducts, pipes, and other obstructions.

3.7 RECESSED ENTRANCE GRATING

Contractor shall verify field measurements prior to releasing materials for fabrication by the manufacturer. A mat frame shall be used to ensure recess accuracy in size, shape and depth. Drain pit shall be formed by blocking out concrete when frames are installed. Pit shall be dampproofed after concrete has set. Frames shall be assembled onsite and installed so that upper edge will be level with finished floor surface. A cement base shall be screeded inside the mat recess frame area using the edge provided by the frame as a guide. The frame shall be anchored into the cement with anchor pins a minimum of 610 mm on centers.

3.8 MOUNTING OF SAFETY CHAINS

Safety chains shall be mounted 1070 mm and 610 mm above the floor.

3.9 INSTALLATION OF SAFETY NOSINGS

Nosing shall be completely embedded in concrete before the initial set of the concrete occurs and shall finish flush with the top of the concrete surface.

3.10 TRENCH FRAMES AND COVERS

Trench frames and covers shall finish flush with the floor.

3.11 FLOOR DOORS

Coordinate installation of all cast-in-place components. Install frame and door components in complete accord with manufacturer's printed instruction for rated assemblies. Coordinate location of ladder to ensure that required minimum separation distances are maintained between hatch and ladder. Coordinate location of guardrail at attic floor to ensure that floor door operates without interference. Install intumescent coating at perimeter of floor penetration per manufacturer's written instructions to maintain fire rating.

3.12 LADDERUP SAFETY POST

Verify ladder geometry prior to fabrication of components. Do not begin installation of safety post before confirming that it will not impact attic access by other trades. Comply with all manufacturer's written instructions for installation. Use manufacturer's fasteners.

END OF SECTION

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SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN FOREST & PAPER ASSOCIATION (AF&PA)

AF&PA T01 (1991; Supple 1993; Addenda Apr 1997; Supple T02)
National Design Specification for Wood Construction

AF&PA T11 (1988) Manual for Wood Frame Construction

AMERICAN HARDBOARD ASSOCIATION (AHA)

AHA A135.4 (1995) Basic Hardboard

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION (AITC)

AITC TC Manual (1994) Timber Construction Manual

AITC 109 (1990) Standard for Preservative Treatment of
Structural Glued Laminated Timber

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 307 (2000) Carbon Steel Bolts and Studs, 60 000 PSI
Tensile Strength

ASTM C 79/C 79M (2000) Treated Core and Nontreated Core Gypsum
Sheathing Board

ASTM C 518 (1998) Steady-State Heat Flux Measurements and
Thermal Transmission Properties By Means of the Heat
Flow Meter Apparatus

ASTM C 1177/C 1177M (1999) Glass Mat Gypsum Substrate for Use as
Sheathing

ASTM D 2898 (1994; R 1999) Accelerated Weathering of Fire-
Retardant-Treated Wood for Fire Testing

ASTM D 3498 (1999) Standard Specification for Adhesives for Field-
Gluing Plywood to Lumber Framing for Floor Systems

ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM F 547	(1977; R 1995) Definitions of Terms Relating to Nails for Use with Wood and Wood-Base Materials

AMERICAN WOOD-PRESERVERS' ASSOCIATION (AWPA)

AWPA C2	(2000) Lumber, Timber, Bridge Ties and Mine Ties - Preservative Treatment by Pressure Processes
AWPA C9	(1997) Plywood - Preservative Treatment by Pressure Processes
AWPA C27	(1999) Plywood - Fire-Retardant Pressure Treatment
AWPA M4	(1999) Standard for the Care of Preservative-Treated Wood Products
AWPA P5	(2000) Standards for Waterborne Preservatives

APA - THE ENGINEERED WOOD ASSOCIATION (APA)

APA EWS R540C	(1996) Builder Tips Proper Storage and Handling of Glulam Beams
APA PRP-108	(1980; Rev Jan 1996) Performance Standards and Policies for Structural-Use Panels

CALIFORNIA REDWOOD ASSOCIATION (CRA)

CRA RIS-01-SS	(1997) Standard Specifications for Grades of California Redwood Lumber
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DEPARTMENT OF COMMERCE (DOC)

DOC PS 1	(1996) Voluntary Product Standard - Construction and Industrial Plywood
DOC PS 2	(1992) Performance Standards for Wood-Based Structural-Use Panels

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM LPD 1-49 (1995) Loss Prevention Data Sheet - Perimeter
Flashing

FOREST STEWARDSHIP COUNCIL (FSC)

(2002) Listing of Certified Wood Products

FM LPD 1-49 (1995) Loss Prevention Data Sheet - Perimeter
Flashing

NATIONAL HARDWOOD LUMBER ASSOCIATION (NHLA)

NHLA Rules (1994) Rules for the Measurement & Inspection of
Hardwood & Cypress

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for Northeastern
Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Specs (1986; Supple No. 1, Aug 1993) Standard Specifications
for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules (1994; Supple 8 through 11) Standard Grading Rules
for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17 (1996; Supplements VII(A-E), VIII(A-C)) Grading Rules
for West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules (1999) Western Lumber Grading Rules 95

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-07 Certificates

Grading and Marking; "G"

Manufacturer's certificates (approved by an American Lumber Standards approved agency) attesting that lumber and material not normally grade marked meet the specified requirements. Certificate of Inspection for grade marked material by an American Lumber Standards Committee (ALSC) recognized inspection agency prior to shipment.

For all wood products incorporated as "certified wood" provide evidence of compliance with Forest Stewardship Council (FSC) standards for certified wood. Evidence shall consist of suppliers invoices with certified products indicated on a line item basis.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well ventilated areas, and protected from extreme changes in temperature and humidity. Laminated timber shall be handled and stored in accordance with AITC 111 or APA EWS R540C.

1.4 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of rough carpentry with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Elimination of wood materials from all fire rated construction.
- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Verification that wood products are fire retardant or preservative treated in all areas specified.
- (6) Inspection of all wood members to ensure complete attachment to adjacent framing.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 LUMBER AND SHEATHING

2.1.1 Grading and Marking

2.1.1.1 Lumber Products

Solid sawn and finger-jointed lumber shall bear an authorized gradestamp or grademark recognized by ALSC, or an ALSC recognized certification stamp, mark, or hammerbrand. Surfaces that are to be exposed to view shall not bear grademarks, stamps, or any type of identifying mark. Hammer marking will be permitted on timbers when all surfaces will be exposed to view.

2.1.1.2 Plywood and Other Products

Materials shall bear the grademark or other identifying marks indicating grades of material and rules or standards under which produced, including requirements for qualifications and authority of the inspection organization. Except for plywood and wood structural panels, bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be exposed to view shall not bear grademarks or other types of identifying marks.

2.1.2 Sizes

Lumber and material sizes shall conform to requirements of the rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Unless otherwise specified, sizes indicated are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Treatment

Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWWA M4. Items of all-heart material of cedar, cypress, or redwood will not require preservative treatment, except when in direct contact with soil. Except as specified for all-heart material of the previously mentioned species, the following items shall be treated:

- a. Wood members in contact with or within 450 mm of soil.
- b. Wood members in contact with water.
- c. Wood members exposed to the weather including those used in built-up roofing systems or as nailing strips or nailers over fiberboard or gypsum-board wall sheathing.
- d. Wood members set into concrete regardless of location, including flush-with-deck wood nailers for roofs.
- e. Wood members in contact with concrete that is in contact with soil or water or that is exposed to weather.

- f. Wood members used as blocking under metal flashing exposed to the weather.

2.1.3.1 Lumber and Timbers

Lumber and timbers shall be treated in accordance with AWPAC2 with waterborne preservatives listed in AWPAC5 to a retention level as follows:

- a. 4 kg per cubic meter intended for above ground use.
- b. 6.4 kg per cubic meter intended for ground contact and fresh water use.

2.1.3.2 Plywood

Plywood shall be treated in accordance with AWPAC9 with waterborne preservatives listed in AWPAC5 to a retention level as follows:

- a. 4 kg per cubic meter intended for above ground use.
- b. 6.4 kg per cubic meter intended for ground contact and fresh water use.

2.1.4 Moisture Content

At the time lumber and other materials are delivered and when installed in the work their moisture content shall be as follows:

- a. Treated and Untreated Lumber Except Roof Planking:
 - 100 mm or less, nominal thickness, 19 percent maximum.
 - 125 mm or more, nominal thickness, 23 percent maximum in a 75 mm perimeter of the timber cross-section.
- b. Materials Other Than Lumber: In accordance with standard under which product is produced.

2.1.5 Fire-Retardant Treatment

Fire-retardant treated wood shall be pressure treated in accordance with AWPAC20 for lumber and AWPAC27 for plywood. Material use shall be defined in AWPAC20 and AWPAC27 for Interior Type A and Exterior Type. Treatment and performance inspection shall be by an independent and qualified testing agency that establishes performance ratings. Each piece or bundle of treated material shall bear identification of the testing agency to indicate performance in accordance with such rating. Treated materials to be exposed to rain wetting shall be subjected to an accelerated weathering technique in accordance with ASTM D 2898 prior to being tested for compliance with AWPAC20 or AWPAC27. Items to be treated include: plywood used for backboards and mounting boards for mechanical or electrical equipment. Any miscellaneous wood blocking or bracing used in interior construction.

Fire retardant treatment of plywood used in roof construction is prohibited due to accelerated decay of treated products in wet environments.

2.1.6 Miscellaneous Wood Members

2.1.6.1 Nonstress Graded Members

Members shall include bridging, furring, grounds, and nailing strips. Members shall be in accordance with TABLE I for the species used. Sizes shall be as follows unless otherwise shown:

Member	Size mm (inch)
Furring	25 (1) x 75 (3)
Nailing strips	25 x 75 (1 x 3) or 25 x 100 (1 x 4) when used as shingle base or interior finish, otherwise 50 mm (2 inch) stock.

2.1.6.2 Blocking

Blocking shall be standard or number 2 grade.

2.1.7 Certified Wood

A minimum of 50 percent of all lumber and panel products provided under this specification shall be certified wood meeting Forest Stewardship Council standards and certification.

2.2 ACCESSORIES AND NAILS

Markings shall identify both the strength grade and the manufacturer. Accessories and nails shall conform to the following:

2.2.1 Anchor Bolts

ASTM A 307, size as indicated, complete with nuts and washers.

2.2.2 Bolts: Lag, Toggle, and Miscellaneous Bolts and Screws

Type, size, and finish best suited for intended use. Finish options include zinc compounds, cadmium, and aluminum paint impregnated finishes.

2.2.3 Clip Angles

Steel, 5 mm thick, size best suited for intended use; or zinc-coated steel or iron commercial clips designed for connecting wood members.

2.2.4 Expansion Shields

Type and size best suited for intended use.

2.2.5 Nails and Staples

ASTM F 547, size and type best suited for purpose; staples shall be as recommended by the manufacturer of the materials to be joined. For sheathing, length of nails shall be sufficient to

extend 25 mm into supports. In general, 8-penny or larger nails shall be used for nailing through 25 mm thick lumber and for toe nailing 50 mm thick lumber; 16-penny or larger nails shall be used for nailing through 50 mm thick lumber. Nails used with treated lumber and sheathing shall be galvanized. Nailing shall be in accordance with the recommended nailing schedule contained in AF&PA T11. Where detailed nailing requirements are not specified, nail size and spacing shall be sufficient to develop an adequate strength for the connection. The connection's strength shall be verified against the nail capacity tables in AF&PA T01. Reasonable judgement backed by experience shall ensure that the designed connection will not cause the wood to split. If a load situation exceeds a reasonable limit for nails, a specialized connector shall be used.

PART 3 EXECUTION

3.1 Blocking

Blocking shall be provided as necessary for application of sheathing, wallboard, and other materials or building items where light gauge steel members cannot be used. Blocking shall be cut to fit between framing members and rigidly screwed thereto.

3.2 Nailers and Nailing Strips

Nailers and nailing strips shall be provided as necessary for the attachment of finish materials. Nailers used in conjunction with roof deck installation shall be installed flush with the roof deck system. Stacked nailers shall be assembled with spikes or nails spaced not more than 450 mm on center and staggered. Beginning and ending nails shall not be more than 150 mm for nailer end. Ends of stacked nailers shall be offset approximately 300 mm in long runs and alternated at corners. Anchors shall extend through the entire thickness of the nailer. Strips shall be run in lengths as long as practicable, butt jointed, cut into wood framing members when necessary, and rigidly secured in place. Nailers and nailer installation for Factory Mutual wind uplift rated roof systems specified in other Sections of these specifications shall conform to the recommendations contained in FM LPD 1-49.

3.3 Wood Grounds

Wood grounds shall be provided as necessary for attachment of trim, finish, and other work to plaster. Grounds shall be run in lengths as long as practicable, butt jointed, and rigidly secured in place.

3.4 Furring Strips

Furring strips shall be provided at the locations shown. Furring strips shall be installed at 400 mm on center unless otherwise shown, run in lengths as long as practicable, butt jointed and rigidly secured in place.

3.5 TABLES

TABLE I. SPECIES AND GRADE

Roof Sheathing, Furring						
Grading Rules	Species	Const Standard	No. 2 Comm	No. 2 Board Comm	No. 3 Comm	
NHLA Rules	Cypress			X		
NELMA Grading Rules	Northern White Cedar					X
	Eastern White Pine	X				
	Northern Pine	X				
	Balsam Fir					X
	Eastern Hemlock- Tamarack					X
CRA RIS-01-SS	Redwood		X			
SCMA Specs	Cypress			X		
SPIB Rules	Southern Pine		X			
WCLIB Std 17	Douglas Fir-Larch	X				
	Hem-Fir	X				
	Sitka Spruce	X				
	Mountain Hemlock	X				
	Western Cedar	X				
WWPA Grading Rules	Douglas Fir-Larch	X				
	Hem-Fir	X				
	Idaho White Pine	X				
	Lodgepole Pine				X	
	Ponderosa Pine				X	
	Sugar Pine				X	
	Englemann Spruce				X	
	Douglas Fir South				X	
	Mountain Hemlock				X	
	Subalpine Fir				X	
	Western Cedar				X	

END OF SECTION

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SECTION 06200

FINISH CARPENTRY

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Quality Standards (1999) Architectural Woodwork Quality Standards

NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION (NELMA)

NELMA Grading Rules (1997) Standard Grading Rules for Northeastern Lumber

SOUTHERN CYPRESS MANUFACTURERS ASSOCIATION (SCMA)

SCMA Specs (1986; Supple No. 1, Aug 1993) Standard Specifications for Grades of Southern Cypress

SOUTHERN PINE INSPECTION BUREAU (SPIB)

SPIB Rules (1994; Supple 8 through 11) Standard Grading Rules for Southern Pine Lumber

WEST COAST LUMBER INSPECTION BUREAU (WCLIB)

WCLIB Std 17 (1996; Supples VII(A-E), VIII(A-C)) Grading Rules For West Coast Lumber

WESTERN WOOD PRODUCTS ASSOCIATION (WWPA)

WWPA Grading Rules (1999) Western Lumber Grading Rules 95

WOOD MOULDING AND MILLWORK PRODUCERS ASSOCIATION (WMMPA)

WMMPA WM 6 (1987) Industry Standard for Non-Pressure Treating of Wood Millwork

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Finish Carpentry; "G", A/S

Drawings showing fabricated items and special mill and woodwork items. Drawings shall indicate materials and details of construction, methods of fastening, erection, and installation.

SD-03 Product Data

Manufacturer's printed data, showing texture, density, catalog cuts, and installation instructions.

Wood Items, and Trim; "G"

Manufacturer's printed data indicating the usage of engineered or recycled wood products, and environmentally safe preservatives.

SD-04 Samples

Samples shall be of sufficient size to show patterns, color ranges, and types, as applicable, of the material proposed to be used.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in undamaged condition, stored off ground in fully covered, well-ventilated areas, and protected from extreme changes in temperature and humidity.

1.4 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of finish carpentry with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades and field measurement verification of all dimensions where adjacent construction constrains the installation of woodwork.
- (4) Aesthetic consistency of wood grain, surface plane, joints, color, and finish with specified requirements.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 WOOD ITEMS AND TRIM

The Contractor shall furnish products which optimize design by reducing the amount of wood used (engineered wood), by using recycled wood products and preservatives without arsenic or chromium when the products and methods are competitive in price or directed by the Contracting Officer. Recyclable products shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS.

2.1.1 Grading and Marking

Materials shall bear the grademark, stamp or other identifying marks indicating grades of material and rules or standards under which produced. Such identifying marks on a material shall be in accordance with the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification. The inspection agency for lumber shall be certified by the Board of Review, American Lumber Standards Committee, to grade the species used. Bundle marking will be permitted in lieu of marking each individual piece. Surfaces that are to be architecturally exposed to view shall not bear grademarks, stamps, or other types of identifying marks.

2.1.2 Sizes and Patterns

Lumber sizes and patterns shall conform to rules or standards under which produced. Unless otherwise specified, lumber shall be surfaced on four sides. Sizes and patterns for materials other than lumber shall conform to requirements of the rules or standards under which produced. Size references, unless otherwise specified, are nominal sizes, and actual sizes shall be within manufacturing tolerances allowed by the standard under which the product is produced.

2.1.3 Moisture Content

The maximum moisture content of untreated trim shall be 15 percent at the time of delivery to the job site and when installed. Moisture content of all other material shall be in accordance with the standard under which the product is produced.

2.1.4 Exterior Trim

Fascias and trim, including exterior door and window casing, shall be species and grade listed in TABLE I at the end of this section. Sizes shall be as indicated. Metal corners may be furnished in lieu of wood cornerboards for horizontal siding; and if furnished, shall be galvanized steel and primed or aluminum and primed.

2.1.5 Moldings and Interior Trim

Wood for moldings and trim including door and window trim, column caps, cornices, handrail cap, chair rails, wainscot and base molding shall conform top AWI Custom Grade, Red Oak, for transparent finish. Moldings shall be of the pattern indicated and shall be of a grade compatible with the finish specified.

2.1.12.1 Bulletin Boards

Bulletin boards shall have a hardwood or aluminum frame, 6 mm (1/4 inch) plywood or hardboard back; and a 6 mm (1/4 inch), dense, smooth faced corkboard face securely cemented to the back.

2.1.6 Utility Shelving

Utility shelving shall be a suitable species equal to or exceeding requirements of No. 3 Common white fir under WWPA Grading Rules, 25 mm thick; or plywood, interior type, Grade A-B, 13 mm thick, any species group, with 3 mm solid wood edge banding on visible edges.

2.2 NAILS AND STAPLES

Nails shall be the size and type best suited for the purpose and shall conform to ASTM F 547. Nails shall be hot-dip galvanized or aluminum when used on exterior work. Screws for use where nailing is impractical shall be size best suited for purpose. Staples shall be used only on exterior construction. All depressions in trim caused by stapling shall be filled flush prior to painting.

2.3 PRESERVATIVE TREATMENT

All exterior trim in contact with concrete or masonry shall be preservative treated. Treatment shall be in accordance with AWPAC Standard C2 (water borne preservatives only) for above ground contact. Wood shall be air dried or kiln dried to the moisture content specified for lumber and marked with the word "Dry". Creosote or coal-tar solutions shall not be used. Exposed areas of treated wood that are cut or drilled after treatment shall receive a field treatment in accordance with AWPAC M4.

PART 3 EXECUTION

3.1 EXTERIOR TRIM

Exposed surfaces and square edges shall be machine sanded, caulked, and constructed to exclude water. Joints of built-up items, in addition to nailing, shall be glued as necessary for weather-resistant construction. End joints in built-up members shall be well distributed. Joints in flat work shall be shouldered. Backs of wide-faced miters shall be held together with metal rings and glue. Fascias and other flat members shall be in maximum practicable lengths. Cornices shall be braced, blocked, and rigidly anchored for support and protection of vertical joints.

3.2 MOLDING AND INTERIOR TRIM

Molding and interior trim shall be installed straight, plumb, level and with closely fitted joints. Exposed surfaces shall be machine sanded at the mill. Molded work shall be coped at returns and interior angles and mitered at external corners. Intersections of flatwork shall be shouldered to ease any inherent changes in plane. Window and door trim shall be provided in single lengths. Blind nailing shall be used to the extent practicable, and face nailing shall be set and stopped with a nonstaining putty to match the finish applied. Screws shall be used

for attachment to metal; setting and stopping of screws shall be of the same quality as required where nails are used.

3.3 Bulletin Boards and Chalkboards

Items shall be installed in accordance with the manufacturer's recommendation.3.4 SHELVING

Shelving shall be anchored to supporting construction. Unless otherwise indicated, shelves shall be supported by wall-supported brackets not more than 600 mm on center or as required to limit deflection to 6 mm between supports with a load of 525 N per meter (35 lb per lineal foot). Adjustable shelf hardware shall be steel standards, channel shaped, with 25 mm adjustment slots and brackets designed for attachment to standards. Shelving in Barracks Room Modules shall be supported by brackets that incorporate support for clothes hanger rods. Anchor all brackets to studs or solid blocking concealed in wall. Brackets shall support a combined shelf and clothes hanger rod load of 1500 N per meter (100 lb per lineal foot).

3.5 CLOTHES HANGER RODS

Rods shall be provided in continuous sections below all closet shelving in Barracks Room Modules, in all closets having hook strips, and where indicated. Rods shall be aluminum pipe or tubing 25 mm in diameter. Rods shall be set parallel with the front edges of the shelving, and shall be supported at each end by suitable sockets, and by intermediate brackets spaced at not more than 1200 mm centers.

3.6 FINISHES

3.6.1 Exterior Trim

Exterior trim shall be painted in accordance with SECTION: PAINTING, GENERAL.

3.6.1 Molding, Interior Trim and Shelving

In preparation for finishing, all trim shall be sanded to remove machine marks, scratches and surface defects that would be highlighted by staining. Trim shall then be brushed off and wiped with a tack rag to remove all dust. A wiping stain shall then be applied followed by three coats of satin luster polyurethane. Stain and polyurethane shall be as specified in SECTION: PAINTING, GENERAL. Polyurethane shall be buffed between coats with fine sandpaper or steel wool to remove surface imperfections. After installation, all flaws in the finish caused during the installation shall be lightly sanded and touched up with stain and polyurethane. Stain colors shall be as indicated in the finish schedule, or if not indicated, shall be the same color for all woodwork in a given area of the building. If the location or extent of stain colors is unclear the Contractor shall ask for clarification from the Contracting Officer.

3.7 TABLES

TABLE I. SPECIES AND GRADE TABLES

Grading & Rules	Species	Choice	Clear	C Select	Better
CRA RIS-01-SS	Redwood		X		
SPIB Rules	Southern Pine				X
WCLIB Std 17	Douglas Fir				X
	Larch				X
	Hemlock Fir				X
	Mountain Hemlock				X
	Sitka Spruce				X
WWPA Grading Rules	Douglas Fir				X
	Larch				X
	Hemlock Fir		X		
	Mountain Hemlock				X
	Western Larch		X		
	Idaho White Pine	X			
	Lodgepole Pine		X		
	Ponderosa Pine		X		
	Sugar Pine		X		
	Englemann Spruce		X		
	Douglas Fir South		X		
	Subalpine Fir		X		

NOTE 1: Western Cedar under WCLIB Std 17 shall be Grade B; and under WWPA Grading Rules, Western Cedar shall be Grade A For trim.

NOTE 2: Except as specified in NOTE 3 below, exterior trim shall be any of the species listed above. Interior trim shall be any one of the species listed above and the highest grade of the species for stain or natural finish and one grade below highest grade of species for paint finish.

NOTE 3: Southern Yellow Pine, Douglas Fir, Larch, Western Larch, and Tamarack shall not be used where painting is required and may be used on exterior work only when approved and stained with a preservative type stain.

END OF SECTION

SECTION 06410

LAMINATE CLAD ARCHITECTURAL CASEWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Qual. Stds. (1999) Architectural Woodwork Quality Standards.

FOREST STEWARDSHIP COUNCIL (FSC)

(2002) Listing of Certified Wood Products.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High Pressure Decorative Laminates

NEMA LD 3.1 (1995) Performance, Application, Fabrication, and Installation of High Pressure Decorative Laminates

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI A161.2 (1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ANSI A208.1 (1999) Particleboard Mat Formed Woods

ANSI A208.2 (1994) Medium Density Fiberboard (MDF)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1037 (1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

ASTM E 84 (2000a) Surface Burning Characteristics of Building Materials

ASTM F 547 (1977; R 1995) Definition of Terms Relating to Nails for Use with Wood and Wood-Based Materials.

BAY AREA (California) AIR RESOURCES BOARD REGULATION (BAARBR)

Rule 8.51 (2001) Adhesive and Sealant Products

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9 (1994) Cabinet Hardware

NATIONAL WOOD WINDOW & DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A (1997) Architectural Wood Flush Doors

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

Rule 1168 (2000) Adhesive and Sealant Applications

1.2 GENERAL DESCRIPTION

Work in this section includes laminate clad custom casework cabinets, vanities, countertops, and service counters as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Recyclable materials shall conform to EPA requirements in accordance with SECTION: RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09900 PAINTING, GENERAL.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Shop Drawings; "G", A/S
Installation;

Shop drawings showing all fabricated casework items in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials; "G"
Wood Finishes; "G"

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Quality Standards for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes re-cycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates; "G",

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm 5 by 7 inches in size.

Cabinet Hardware; "G",

One sample of each cabinet hardware item specified to include hinges, pulls, and drawer glides.

SD-07 Certificates

Quality Assurance; "G"
Laminate Clad Casework; "G"

A quality control statement that illustrates compliance with and understanding of AWI Quality Standards. requirements, in general, and the specific AWI Quality Standards requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's (or manufacturer's) experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

For all wood products incorporated as "certified wood" provide evidence of compliance with Forest Stewardship Council (FSC) standards for certified wood. Evidence shall consist of suppliers invoices with certified products indicated on a line item basis.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Quality Standards, Section 400G and Section 400B for laminate clad cabinets. These

standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Quality Standards requirements for the quality grade indicated.

1.5 MOCK-UP

Prior to final approval of shop drawings, a full-size mock-up shall be provided of a typical bathroom vanity and kitchen cabinetry. The mock-up shall include all components and hardware necessary to illustrate a completed unit and shall include a minimum of one door and one drawer assembly. The completed mock-up shall include countertops and back splashes where specified. The mock-up shall utilize specified finishes in the patterns and colors as indicated on the drawings. Upon disapproval, the Contractor shall rework or remake the mock-up until approval is secured. Rejected units shall be removed from the jobsite. Approved mock-up may remain as part of the finished work.

1.6 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

1.8 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of casework with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades and dimensions to be verified.
- (4) Mock-ups are built and provided with all features indicated and specified.

(5) Locations of removable panels are coordinated with required access for mechanical and electrical equipment or fixtures.

(6) Protection of all casework and laminate surfaces until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 19-mm hardwood.

2.1.1.1 Standing and Running Trim

Standing or running trim casework components that are specified to receive a transparent finish shall be Red Oak plain sawn. AWI grade shall be custom. Location, shape, and dimensions shall be as indicated on the drawings.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Quality Standards Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings. Plywood shall not be used as a substrate for laminate faced vertical or horizontal surfaces.

2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (640 to 800 kg per cubic meter (40 to 50 pounds per cubic foot), 19 mm. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered countertops and backsplashes and other areas subjected to moisture including all bathroom vanity cabinetry. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate. Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

2.2 CERTIFIED WOOD

A minimum of 50 percent of all lumber and panel products provided under this specification shall be certified wood meeting Forest Stewardship Council standards and certification.

2.3 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.3.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. This laminate grade shall be applied on horizontal surfaces where postforming is not required.

2.3.2 Vertical General Purpose Standard (VGS) Grade

Vertical general purpose standard grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade is intended for exposed exterior vertical surfaces of casework components where postforming is not required.

2.3.3 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 1.07 mm (plus or minus 0.127 mm) in thickness. This laminate grade shall be applied on horizontal surfaces where post forming is required.

2.3.4 Vertical General Purpose Postformable (VGP) Grade

Vertical general purpose postformable grade plastic laminate shall be 0.71 mm (plus or minus 0.012 mm) in thickness. This laminate grade shall be applied on exposed exterior vertical surfaces of components where postforming is required for curved surfaces.

2.3.5 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.51 mm 0.020 inches. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.4 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior and drawer interior surfaces.

2.5 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.5 mm thick. Material width shall be as indicated on the drawings. Color and pattern shall be as indicated on the drawings

2.6 VINYL COUNTERTOP EDGE

Where located on the drawings, vinyl edging for countertops shall be a tee-mould anchor type with a flatedge profile. Finished width shall be as indicated on the drawings. Color shall be as indicated on the drawings.

2.7 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

- a. Door Hinges: stainless steel, concealed type (Euro hinge), self closing, full overlay 110 degree minimum opening, BHMA No. BO1602.
- b. Cabinet Pulls (doors and drawers): stainless steel, satin finish, wire type, 10 mm diameter x 140 mm length, BHMA No. BO2011.
- c. Drawer Slide: Side mounted metal type, BHMA No. BO5051 with full extension and a minimum 45 kg load capacity. Slides shall include, ball bearing guides, over travel detent, and an integral stop to avoid accidental drawer removal.
- d. Adjustable Shelf Support System shall be contractors option of:
 - 1) Recessed (mortised) metal standards, BHMA No. BO4071, finish: sating stainless steel. Support clips for the standards shall be open type, BHMA No. B04091, finish: sating stainless steel, or
 - 2) Multiple holes with metal pin supports, BHMA No. BO4013.

2.8 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.9 ADHESIVES, CAULKS, AND SEALANTS

2.9.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing. Adhesives shall meet the VOC limits established by the South Coast Air Quality Management District Rule No. 1168.

2.9.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use urea-formaldehyde resin formula. Adhesives shall withstand a bond test as described in NWWDA I.S. 1-A.

2.9.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.9.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.9.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture. Sealants used as filler shall meet the Bay Area Air Resources Board Regulation 8, Rule 51.

2.10 WOOD FINISHES

Paint, stain, varnish and their applications required for laminate clad casework components shall be as indicated in SECTION: PAINTING, GENERAL. Color and location shall be as indicated on the drawings.

2.11 ACCESSORIES

2.11.1 Glass and Glazing

Glass required in laminated casework shall be referenced by type in accordance with Section 08810 GLASS AND GLAZING. Glass shall be one of the following:

- a. Safety glass: Clear; laminated; 4 mm thick minimum.
- b. Wire Glass: Clear, polished both sides; square mesh woven stainless steel wire of grid 12 mm size; 6 mm thick.

2.11.2 Grommets

Grommets shall be metal material for cutouts. Locations shall be as indicated on the drawings.

2.12 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Quality Standards, Section 400-G descriptions, shall be flush overlay.

2.12.1 Base and Wall Cabinet Case Body

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

- a. Body Members (Ends, Divisions, Bottoms, and Tops): 19 mm particleboard or medium density fiberboard (MDF) panel product.
- b. Face Frames and Rails: 19 mm hardwood lumber.
- c. Shelving: 19 mm particleboard or medium density fiberboard (MDF) panel product.
- d. Cabinet Backs: 6 mm veneer core plywood panel product.
- e. Drawer Sides, Backs, and Subfronts: 13 mm hardwood lumber.
- f. Drawer Bottoms: 6 mm particleboard or medium density fiberboard (MDF) panel product.
- g. Door and Drawer Fronts: 19mm particleboard or medium density fiberboard (MDF) panel product.

2.12.1.1 Joinery Method for Case Body Members

- a. Tops, Exposed Ends, and Bottoms.

Doweled, glued under pressure (approx. 4 dowels per 300 mm of joint), or

Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners shall not be visible on exposed parts).

- b. Exposed End Corner and Face Frame Attachment.

1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).

2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).

- c. Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.

d. Cabinet Backs (Floor Standing Cabinets) shall be:

1) Side bound, captured in grooves; glued and fastened to top and bottom.

e. Wall Anchor Strips shall be required for all cabinets with backs less than 13 mm thick. Strips shall consist of minimum 13 mm thick lumber, minimum 60 mm width; securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.12.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 50 mm thick, preservative treated lumber (see SECTION: ROUGH CARPENTRY). Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

2.12.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 19 mm medium density fiberboard or particleboard. All door and drawer front edges shall be surfaced with PVC edgebanding, color and pattern to match exterior face laminate.

2.12.4 Drawer Assembly

Drawer components shall consist of a removable unit consisting of drawer front, sides, back, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

- a. Drawer Sides and Backs For Transparent Finish: 13 mm thick solid hardwood lumber
- b. Drawer Bottom: 6 mm thick thermoset decorative overlay melamine panel product.

2.12.4.1 Drawer Assembly Joinery Method

Lock shoulder, glued and pin nailed. Bottoms shall be set into sides, front, and back, in 6 mm deep groove with a minimum 9 mm standing shoulder.

2.12.5 Shelving

Shelving shall be fabricated from 19 mm medium density fiberboard (MDF). All shelving top, bottom and concealed edge surfaces shall be finished with thermoset decorative overlay (melamine). Exposed shelf edges shall be finished in a PVC edgebanding.

2.12.5.1 Shelf Support System

The shelf support system shall be:

- a. Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates

tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

b. Pin Hole Method. Holes shall be drilled on the interior surface of the cabinet side walls. Holes shall be evenly spaced in two vertical columns. The holes in each column shall be spaced at 25 mm increments starting 150 mm from the cabinet interior bottom and extending to within 150 mm of the top interior surface of the cabinet. Holes shall be drilled to provide a level, stable surface when the shelf is resting on the shelf pins. Hole diameter shall be coordinated with pin insert size to provide a firm, tight fit.

2.12.6 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 19 mm particleboard. The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

2.12.6.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be post formed plastic laminate. Laminate edge shall be integral with countertop surface. Shape and profile shall be as indicated on the drawings and to dimensions as indicated on the drawings.

2.12.6.2 Laminate Clad Splashes

Countertop splash substrate shall be 19 mm particleboard. Laminate clad backsplash shall be integral with countertop, coved to radius at base, bullnosed at top, to dimensions as indicated on the drawings. Side splashes shall be straight profile with bullnosed top and provided loose, to be installed at the time of countertop installation. Back and side splash shall meet at a miter joint. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.12.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3.1, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased sharp corners removed. Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to NEMA LD 3.1 and ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

1) Exterior (exposed) surfaces to include exposed and semi-exposed face frame surfaces: HPDL Grade VGS.

2) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).

2) Exposed edges: PVC edgebanding.

c. Fixed Shelving.

1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).

2) Exposed edges: PVC edgebanding .

d. Door, Drawer Fronts, Access Panels.

1) Exterior (exposed) faces: HPDL Grade VGS

2) Edges: PVC edgebanding.

e. Drawer Assembly.

All interior surfaces of drawer bottom and drawer front: Thermoset Decorative Overlay (melamine).

f. Countertops and Splashes.

1) All exposed and semi-exposed surfaces: HPDL Grade HGS

2.12.7.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Quality Standards custom grade requirements.

2.12.8 Finishing

2.12.8.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.12.8.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.12.8.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and Section 09900 PAINTING, GENERAL. All cabinet reveals shall be painted.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Quality Standards custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other laminate clad casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Casework assemblies shall be attached to anchored bases without visible fasteners. Where assembly abuts a wall surface, anchoring shall include a minimum 13 mm thick lumber or panel product hanging strip, minimum 60 mm width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinetry to be wall mounted shall utilize minimum 13 mm thick lumber or panel product hanging strips, minimum 60 mm width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk in a smooth consistent concave bead. Joint width shall not exceed 4 mm.

3.1.2.1 Loose Splashes

Loose sidesplashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks. Joint width shall not exceed 4 mm.

3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Plastic or synthetic insertion dowels shall be used to receive 5 mm "Euro screws" for mounting fully concealed European-style hinges at particleboard or fiberboard doors. The use of wood screws without insertion dowels is prohibited. Install drawer slides using slide manufacturer's recommended type and minimum number of fasteners.

3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Quality Standards custom grade requirements.

3.1.5 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with SECTION: PLUMBING, GENERAL PURPOSE.

3.1.6 Glass

Glass and glazing shall be installed in the casework using methods and materials specified in SECTION: GLASS AND GLAZING in locations as indicated on the drawings.

END OF SECTION

SECTION 06415

CUSTOM CASEWORK

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI Quality Standards (1999) Architectural Woodwork Quality Standards.

FOREST STEWARDSHIP COUNCIL (FSC)

(2002) Listing of Certified Wood Products.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High Pressure Decorative Laminates

NEMA LD 3.1 (1995) Performance, Application, Fabrication, and Installation of High Pressure Decorative Laminates

AMERICAN NATIONAL STANDARD INSTITUTE (ANSI)

ANSI A161.2 (1998) Decorative Laminate Countertops, Performance Standards for Fabricated High Pressure

ANSI A208.1 (1999) Particleboard Mat Formed Woods

ANSI A208.2 (1994) Medium Density Fiberboard (MDF)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1037 (1999) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

ASTM E 84 (2000a) Surface Burning Characteristics of Building Materials

ASTM F 547 (1977; R 1995) Definition of Terms Relating to Nails for Use with Wood and Wood-Based Materials.

BAY AREA (California) AIR RESOURCES BOARD REGULATION (BAARBR)

Rule 8.51 (2001) Adhesives and Sealant Products.

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA)

BHMA A156.9 (1994) Cabinet Hardware

NATIONAL WOOD WINDOW & DOOR ASSOCIATION (NWWDA)

NWWDA I.S. 1-A (1997) Architectural Wood Flush Doors

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT (SCAQMD)

Rule 1168 (2000) Adhesive and Sealant Applications.

1.2 GENERAL DESCRIPTION

Work in this section includes custom wood casework as shown on the drawings and as described in this specification. This Section includes high-pressure laminate surfacing and cabinet hardware. Recyclable materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. All exposed and semi-exposed surfaces, whose finish is not otherwise noted on the drawings or finish schedule, shall be sanded smooth and shall receive a clear finish of polyurethane. Wood finish may be shop finished or field applied in accordance with Section 09900 PAINTING, GENERAL.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. All items designated with a "G", including product literature, calculations, component data, certificates, diagrams, drawings, and samples shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES.

SD-02 Shop Drawings

Shop Drawings; G, A/S
Installation;

Shop drawings showing all fabricated casework items (such as display cases with benches, break room cabinets, bulletin boards and countertops) in plan view, elevations and cross-sections to accurately indicate materials used, details of construction, dimensions, methods of fastening and erection, and installation methods proposed. Shop drawing casework items shall be clearly cross-referenced to casework items located on the project drawings. Shop drawings shall include a color schedule of all casework items to include all countertop, exposed, and semi-exposed cabinet finishes to include finish material manufacturer, pattern, and color.

SD-03 Product Data

Wood Materials;
Wood Finishes; G
Finish Schedule; G

Descriptive data which provides narrative written verification of all types of construction materials and finishes, methods of construction, etc. not clearly illustrated on the submitted shop drawings. Data shall provide written verification of conformance with AWI Quality Standards for the quality indicated to include materials, tolerances, and types of construction. Both the manufacturer of materials and the fabricator shall submit available literature which describes recycled product content, operations and processes in place that support efficient use of natural resources, energy efficiency, emissions of ozone depleting chemicals, management of water and operational waste, indoor environmental quality, and other production techniques supporting sustainable design and products.

SD-04 Samples

Plastic Laminates; G

Two samples of each plastic laminate pattern and color. Samples shall be a minimum of 120 by 170 mm in size.

Cabinet Hardware; G

One sample of each cabinet hardware item specified to include hinges, pulls, drawer glides, and locks.

Solid Hardwood, with or for Transparent Finish; G

Hardwood Plywood or Veneer with or for Transparent Finish; G

Stain/Color Samples, 50 mm by 75 mm; G

SD-07 Certificates

Quality Assurance; G

A quality control statement which illustrates compliance with and understanding of AWI Quality Standards requirements, in general, and the specific AWI Quality Standards requirements provided in this specification. The quality control statement shall also certify a minimum of ten years contractor's experience in laminate clad casework fabrication and construction. The quality control statement shall provide a list of a minimum of five successfully completed projects of a similar scope, size, and complexity.

For all wood products incorporated as "certified wood" provide evidence of compliance with Forest Stewardship Council (FSC) standards for certified wood. Evidence shall consist of suppliers invoices with certified products indicated on a line item basis.

1.4 QUALITY ASSURANCE

Unless otherwise noted on the drawings, all materials, construction methods, and fabrication shall conform to and comply with the custom grade quality standards as outlined in AWI Quality Standards. These standards shall apply in lieu of omissions or specific requirements in this specification. Contractors and their personnel engaged in the work shall be able to demonstrate successful experience with work of comparable extent, complexity and quality to that shown and specified. Contractor must demonstrate knowledge and understanding of AWI Quality Standards requirements for the quality grade indicated.

1.5 MOCK-UP

Prior to final approval of shop drawings, a full-size mock-up shall be provided of a typical floor cabinet. The mock-up shall include all components and hardware necessary to illustrate a completed unit and shall include a minimum of one door and one drawer assembly. The completed mock-up shall include countertops and back splashes where specified. The mock-up shall utilize specified finishes in the patterns and colors as indicated on the drawings. Upon disapproval, the Contractor shall rework or remake the mock-up until approval is secured. Rejected units shall be removed from the job site. Approved mock-up may remain as part of the finished work.

1.6 DELIVERY AND STORAGE

Casework may be delivered knockdown or fully assembled. All units shall be delivered to the site in undamaged condition, stored off the ground in fully enclosed areas, and protected from damage. The storage area shall be well ventilated and not subject to extreme changes in temperature or humidity.

1.7 SEQUENCING AND SCHEDULING

Work shall be coordinated with other trades. Units shall not be installed in any room or space until painting, and ceiling installation are complete within the room where the units are located. Floor cabinets shall be installed before finished flooring materials are installed.

1.8 PROJECT/SITE CONDITIONS

Field measurements shall be verified as indicated in the shop drawings before fabrication.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of casework with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.

- (3) Shop drawings include explicit identification of coordination with other trades and dimensions to be verified.
- (4) Mock-ups are built and provided with all features indicated and specified.
- (5) Locations of removable panels are coordinated with required access for mechanical and electrical equipment or fixtures.
- (6) Protection of all casework until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 WOOD MATERIALS

2.1.1 Lumber

All framing lumber shall be kiln-dried Grade III to dimensions as shown on the drawings. Frame front, where indicated on the drawings, shall be nominal 19 mm hardwood.

2.1.1.1 Standing and Running Trim

Standing or running trim casework components which are specified to receive a transparent finish shall be solid Red Oak hardwood species, plain sawn. AWI grade shall be custom. Location, shape, and dimensions shall be as indicated on the drawings.

2.1.2 Panel Products

2.1.2.1 Plywood

All plywood panels used for framing purposes shall be veneer core hardwood plywood, AWI Quality Standards Grade AA. Nominal thickness of plywood panels shall be as indicated in this specification and on the drawings.

2.1.2.2 Particleboard

All particleboard shall be industrial grade, medium density (640 to 800 kg per cubic meter, 19 mm thick. A moisture-resistant particleboard in grade Type 2-M-2 or 2-M-3 shall be used as the substrate for plastic laminate covered components as located on the drawings and other areas subjected to moisture. Particleboard shall meet the minimum standards listed in ASTM D 1037 and ANSI A208.1.

2.1.2.3 Medium Density Fiberboard

Medium density fiberboard (MDF) shall be an acceptable panel substrate where noted on the drawings. Medium density fiberboard shall meet the minimum standards listed in ANSI A208.2.

2.1.3 Certified Wood

A minimum of 50 percent of all lumber and panel products provided under this specification shall be certified wood meeting Forest Stewardship Council standards and certification.

2.2 HIGH PRESSURE DECORATIVE LAMINATE (HPDL)

All plastic laminates shall meet the requirements of NEMA LD 3 and ANSI A161.2 for high-pressure decorative laminates. Design, colors, surface finish and texture, and locations shall be as indicated on the drawings. Plastic laminate types and nominal minimum thicknesses for casework components shall be as indicated in the following paragraphs.

2.2.1 Horizontal General Purpose Standard (HGS) Grade

Horizontal general purpose standard grade plastic laminate shall be 1.22 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces where postforming is not required.

2.2.2 Horizontal General Purpose Postformable (HGP) Grade

Horizontal general purpose postformable grade plastic laminate shall be 1.07 mm (plus or minus 0.127 mm) in thickness. This laminate grade is intended for horizontal surfaces where post forming is required.

2.2.3 Cabinet Liner Standard (CLS) Grade

Cabinet liner standard grade plastic laminate shall be 0.51 mm in thickness. This laminate grade is intended for light duty semi-exposed interior surfaces of casework components.

2.2.4 Backing Sheet (BK) Grade

Undecorated backing sheet grade laminate is formulated specifically to be used on the backside of plastic laminated panel substrates to enhance dimensional stability of the substrate. Backing sheet thickness shall be 0.51 mm. Backing sheets shall be provided for all laminated casework components where plastic laminate finish is applied to only one surface of the component substrate.

2.3 THERMOSET DECORATIVE OVERLAYS (MELAMINE)

Thermoset decorative overlays (melamine panels) shall be used for casework cabinet interior and drawer interior surfaces.

2.4 EDGE BANDING

Edge banding for casework doors and drawer fronts shall be PVC vinyl and shall be 0.5 mm thick. Material width shall be as indicated on the drawings. Color and pattern shall be as indicated on the drawings.

2.5 CABINET HARDWARE

All hardware shall conform to BHMA A156.9, unless otherwise noted, and shall consist of the following components:

2.7.1 Bulletin Boards

- a. Door Hinges: piano type, BHMA No. B01491, finish: brushed, clear organic.
- b. Cabinet Lock: BHMA No.E07283, finish zinc with clear organic coating. Key all locks for each individual building the same. Coordinate with SECTION: DOOR HARDWARE.
- c. Flush Bolt shall be as indicated, zinc or brass finish.
- d. Glazing Retaining Clip shall be as indicated.

2.7.2 Break Room Cabinets

- a. Door Hinges: BHMA No. B01603 with zinc or chrome finish.
- b. Cabinet Pulls: 140 by 75 mm, brushed chrome finish.
- c. Drawer Slide: Side mounted type, BHMA No. B05051 with full extension and a minimum 100 pound load capacity. Slides shall include an integral stop to avoid accidental drawer removal.
- d. Adjustable Shelf Support System: Recessed (mortised) metal standards, BHMA No. B04071, finish: zinc. Support clips for the standards shall be open type, BHMA No. B04091 finish: zinc.

2.7.3 Display Cases with Benches

- a. Door Hinges: BHMA No. B01603 with zinc or chrome finish.
- b. Cabinet Pulls: 140 by 75 mm, with finish BHMA 652.
- c. Cabinet Lock: BHMA No.E07283, with finish BHMA 652. Key all locks for each individual building the same. Coordinate with SECTION: DOOR HARDWARE.
- d. Flush Bolt: size as suited for application, zinc or brass finish.
- e. Showcase Glass Door Lock: BHMA B07191, with finish BHMA 652.
- f. By-Passing Door slide: BHMA B07031, Brown.
- g. Glass Shelves and Doors: 6 mm tempered glazing.
- h. Adjustable Shelf Support System: Recessed (mortised) metal standards, BHMA No. B04071, finish: with finish BHMA 652. Support clips for the standards shall be open

type, similar to BHMA No. B04091 finish: zinc with added rubber or plastic coated pads for supporting glass shelves.

2.8 FASTENERS

Nails, screws, and other suitable fasteners shall be the size and type best suited for the purpose and shall conform to ASTM F 547 where applicable.

2.9 ADHESIVES, CAULKS, AND SEALANTS

2.9.1 Adhesives

Adhesives shall be of a formula and type recommended by AWI. Adhesives shall be selected for their ability to provide a durable, permanent bond and shall take into consideration such factors as materials to be bonded, expansion and contraction, bond strength, fire rating, and moisture resistance. Adhesives shall meet local regulations regarding VOC emissions and off-gassing. Adhesives shall meet the VOC limits established by the South Coast Air Quality Management District Rule No. 1168.

2.9.1.1 Wood Joinery

Adhesives used to bond wood members shall be a Type II for interior use polyvinyl acetate resin emulsion. Adhesives shall withstand a bond test as described in NWWDA I.S. 1-A.

2.9.1.2 Laminate Adhesive

Adhesive used to join high-pressure decorative laminate to wood shall be adhesive consistent with AWI and laminate manufacturer's recommendations. PVC edgebanding shall be adhered using a polymer-based hot melt glue.

2.9.2 Caulk

Caulk used to fill voids and joints between laminated components and between laminated components and adjacent surfaces shall be clear, 100 percent silicone.

2.9.3 Sealant

Sealant shall be of a type and composition recommended by the substrate manufacturer to provide a moisture barrier at sink cutouts and all other locations where unfinished substrate edges may be subjected to moisture. Sealants used as filler shall meet the Bay Area Resources Board Regulation 8, Rule 51.

2.10 WOOD FINISHES

Paint, stain, varnish and their applications required for casework components shall be as indicated in SECTION: PAINTING, GENERAL. Color and location shall be as indicated on the drawings.

2.11 ACCESSORIES

2.11.1 Glass and Glazing

Glass required in casework shall be referenced by type in accordance with SECTION: GLASS AND GLAZING. Glass shall be safety glass: clear, fully tempered, 6 mm thick minimum.

2.11.2 Grommets

Grommets shall be plastic material for cutouts with a diameter of 60 mm. Locations shall be as indicated on the drawings.

2.12 FABRICATION

Fabrication and assembly of components shall be accomplished at the shop site to the maximum extent possible. Construction and fabrication of cabinets and their components shall meet or exceed the requirements for AWI custom grade unless otherwise indicated in this specification. Cabinet style, in accordance with AWI Quality Standards, Section 400-G descriptions, shall be flush overlay.

2.12.1 Base and Wall Cabinet Case Body

Frame members shall be glued-together, kiln-dried hardwood lumber. Top corners, bottom corners, and cabinet bottoms shall be braced with either hardwood blocks or water-resistant glue and nailed in place metal or plastic corner braces. Cabinet components shall be constructed from the following materials and thicknesses:

- a. Body Members (Ends, Divisions, Bottoms, and Tops): 19 mm veneer core plywood panel product.
- b. Face Frames and Rails: 19 mm hardwood lumber.
- c. Shelving: 19 mm medium density fiberboard (MDF) panel product.
- d. Cabinet Backs: 6 mm veneer core plywood panel product.
- e. Drawer Sides, Backs, and Subfronts: 13 mm 1/2 inch hardwood lumber.
- f. Drawer Bottoms: 6 mm veneer core plywood panel product.
- g. Door and Drawer Fronts: 19mm veneer core plywood panel product.

2.12.1.1 Joinery Method for Case Body Members

Contractor shall select from one of the following methods for each assembly condition indicated:

- a. Tops, Exposed Ends, and Bottoms.

- 1) Steel "European" assembly screws (37 mm from end, 128 mm on center, fasteners will not be visible on exposed parts).
- 2) Doweled, glued under pressure (approx. 4 dowels per 300 mm of joint).
- 3) Stop dado, glued under pressure, and either nailed, stapled or screwed (fasteners will not be visible on exposed parts).
- 4) Spline or biscuit, glued under pressure.

b. Exposed End Corner and Face Frame Attachment.

- 1) For mitered joint: lock miter or spline or biscuit, glued under pressure (no visible fasteners).
- 2) For non-mitered joint (90 degree): butt joint glued under pressure (no visible fasteners).
- 3) Butt joint, glued and nailed.

c. Cabinet Backs (Wall Hung Cabinets): Wall hung cabinet backs must not be relied upon to support the full weight of the cabinet and its anticipated load for hanging/mounting purposes. Method of back joinery and hanging/mounting mechanisms should transfer the load to case body members. Fabrication method shall be:

- 1) Full bound, captured in grooves on cabinet sides, top, and bottom. Cabinet backs for floor standing cabinets shall be side bound, captured in grooves; glued and fastened to top and bottom.
- 2) Full overlay, plant-on backs with minimum back thickness of 13 mm and minimum No. 12 plated (no case hardened) screws spaced a minimum 80 mm on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.
- 3) Side bound, captured in groove or rabbets; glued and fastened.

d. Cabinet Backs (Floor Standing Cabinets).

- 1) Side bound, captured in grooves; glued and fastened to top and bottom.
- 2) Full overlay, plant-on backs with minimum back thickness of 13 mm and minimum No. 12 plated (no case hardened) screws spaced a minimum 80 mm on center. Edge of back shall not be exposed on finished sides. Anchor strips are not required when so attached.
- 3) Side bound, placed in rabbets; glued and fastened in rabbets.

e. Wall Anchor Strips shall be required for all cabinets with backs less than 13 mm thick. Strips shall consist of minimum 13 mm thick lumber, minimum 60 mm width;

securely attached to wall side of cabinet back - top and bottom for wall hung cabinets, top only for floor standing cabinets.

2.12.2 Cabinet Floor Base

Floor cabinets shall be mounted on a base constructed of nominal 50 mm thick lumber. Base assembly components shall be treated lumber. Finished height for each cabinet base shall be as indicated on the drawings. Bottom edge of the cabinet door or drawer face shall be flush with top of base.

2.12.3 Cabinet Door and Drawer Fronts

Door and drawer fronts shall be fabricated from 19 mm veneer core plywood. All door and drawer front edges shall be surfaced with PVC edgebanding, color and pattern as indicated on the drawings.

2.12.4 Drawer Assembly

Drawer components shall consist of a removable drawer front, sides, backs, and bottom. Drawer components shall be constructed of the following materials and thicknesses:

- a. Drawer Sides and Backs For Transparent Finish: 13 mm thick solid hardwood lumber, any species.
- b. Drawer Bottom: 6 mm thick thermoset decorative overlay melamine panel product.

2.12.4.1 Drawer Assembly Joinery Method

- a. Multiple dovetail (all corners) or French dovetail front/dadoed back, glued under pressure, or
- b. Doweled, glued under pressure.
- c. Bottoms shall be set into sides, front, and back, 6 mm deep groove with a minimum 9 mm standing shoulder.

2.12.5 Shelving

Shelving shall be fabricated from [19 mm medium density fiberboard (MDF)]. All shelving top and bottom surfaces shall be finished with thermoset decorative overlay (melamine). Shelf edges shall be finished in a thermoset decorative overlay (melamine).

2.12.5.1 Shelf Support System

The shelf support system shall be Recessed (mortised) metal shelf standards. Standards shall be mortised flush with the finishes surface of the cabinet interior side walls, two per side. Standards shall be positioned and spaced on the side walls to provide a stable shelf surface that eliminates tipping when shelf front is weighted. Standards shall be installed and adjusted vertically to provide a level, stable shelf surface when clips are in place.

2.12.6 Laminate Clad Countertops

Laminate countertop substrate shall be constructed of 19 mm 3/4 inch veneer core plywood. The substrate shall be moisture-resistant where countertops receive sinks, lavatories, or are subjected to liquids. All substrates shall have sink cutout edges sealed with appropriate sealant against moisture. No joints shall occur at any cutouts. A balanced backer sheet is required.

2.12.6.1 Edge Style

Front and exposed side countertop edges shall be in shapes and to dimensions as shown on the drawings. The countertop edge material shall be post formed plastic laminate. Laminate edge shall be integral with countertop surface. Shape and profile shall be as indicated on the drawings and to dimensions as indicated on the drawings.

2.12.6.2 Laminate Clad Splashes

Countertop splash substrate shall be 19 mm veneer core plywood. Laminate clad backsplash shall be integral with countertop, coved to radius and to dimensions as indicated on the drawings. Side splashes shall be straight profile and provided loose, to be installed at the time of countertop installation. Back and side splash laminate pattern and color shall match the adjacent countertop laminate.

2.12.7 Laminate Application

Laminate application to substrates shall follow the recommended procedures and instructions of the laminate manufacturer and NEMA LD 3.1, using tools and devices specifically designed for laminate fabrication and application. Provide a balanced backer sheet (Grade BK) wherever only one surface of the component substrate requires a plastic laminate finish. Apply required grade of laminate in full uninterrupted sheets consistent with manufactured sizes using one piece for full length only, using adhesives specified herein or as recommended by the manufacturer. Fit corners and joints hairline. All laminate edges shall be machined flush, filed, sanded, or buffed to remove machine marks and eased (sharp corners removed). Clean up at easing shall be such that no overlap of the member eased is visible. Fabrication shall conform to NEMA LD 3.1 and ANSI A161.2. Laminate types and grades for component surfaces shall be as follows unless otherwise indicated on the drawings:

a. Base/Wall Cabinet Case Body.

- 1) Interior (semi-exposed) surfaces to include interior back wall, bottom, and side walls: Thermoset Decorative Overlay (melamine).

b. Adjustable Shelving.

- 1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).
- 2) All edges: PVC edgebanding.

c. Fixed Shelving.

- 1) Top and bottom surfaces: Thermoset Decorative Overlay (melamine).
- 2) Exposed edges: PVC edgebanding.

d. Door, Drawer Fronts, Access Panels.

- 1) Edges: PVC edgebanding.

e. Countertops and Splashes.

- 1) All exposed and semi-exposed surfaces: HPDL Grade HGS

2.12.7.1 Tolerances

Flushness, flatness, and joint tolerances of laminated surfaces shall meet the AWI Quality Standards custom grade requirements.

2.12.8 Finishing

2.12.8.1 Filling

No fasteners shall be exposed on laminated surfaces. All nails, screws, and other fasteners in non-laminated cabinet components shall be countersunk and the holes filled with wood filler consistent in color with the wood species.

2.12.8.2 Sanding

All surfaces requiring coatings shall be prepared by sanding with a grit and in a manner that scratches will not show in the final system.

2.12.8.3 Coatings

Types, method of application and location of casework finishes shall be in accordance with the finish schedule, drawings and SECTION: PAINTING, GENERAL. All cabinet reveals shall be painted.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall comply with applicable requirements for AWI Quality Standards custom quality standards. Countertops and fabricated assemblies shall be installed level, plumb, and true to line, in locations shown on the drawings. Cabinets and other casework assemblies shall be attached and anchored securely to the floor and walls with mechanical fasteners that are appropriate for the wall and floor construction.

3.1.1 Anchoring Systems

3.1.1.1 Floor

Base cabinets shall utilize a floor anchoring system. Anchoring and mechanical fasteners shall not be visible from the finished side of the casework assembly. Cabinet assemblies shall be attached to anchored bases without visible fasteners. Where assembly abuts a wall surface, anchoring shall include a minimum 13 mm thick lumber or panel product hanging strip, minimum 60 mm width; securely attached to the top of the wall side of the cabinet back.

3.1.1.2 Wall

Cabinet and display cases to be wall mounted shall utilize minimum 13 mm lumber or panel product hanging strips, minimum 60 mm width; securely attached to the wall side of the cabinet back, both top and bottom.

3.1.2 Countertops

Countertops shall be installed in locations as indicated on the drawings. Countertops shall be fastened to supporting casework structure with mechanical fasteners, hidden from view. All joints formed by the countertop or countertop splash and adjacent wall surfaces shall be filled with a clear silicone caulk.

3.1.2.1 Loose Splashes

Loose side splashes shall be adhered to both the countertop surface perimeter and the adjacent wall surface with adhesives appropriate for the type of materials to be adhered. Joints between the countertop surface and splash shall be filled with clear silicone caulk in a smooth consistent concave bead. Bead size shall be the minimum necessary to fill the joint and any surrounding voids or cracks.

3.1.3 Hardware

Casework hardware shall be installed in types and locations as indicated on the drawings. Where fully concealed European-style hinges are specified to be used with particleboard or fiberboard doors, the use of plastic or synthetic insertion dowels shall be used to receive 5 mm "Euro screws". The use of wood screws without insertion dowels is prohibited.

3.1.4 Doors, Drawers and Removable Panels

The fitting of doors, drawers and removable panels shall be accomplished within target fitting tolerances for gaps and flushness in accordance with AWI Quality Standards custom grade requirements.

3.1.5 Plumbing Fixtures

Sinks, sink hardware, and other plumbing fixtures shall be installed in locations as indicated on the drawings and in accordance with SECTION: PLUMBING, GENERAL PURPOSE.

3.1.6 Glass

Glass and glazing shall be installed in the casework using methods and materials specified in Section 08810 GLASS AND GLAZING in locations as indicated on the drawings.

END OF SECTION

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SECTION 06610

FIBER REINFORCED PLASTIC (FRP) FABRICATIONS

PART 1 GENERAL

1.1 SCOPE

The work covered by this section includes FRP components of the entrance porticos including columns, pilasters, and entablature as indicated on the drawings. Work includes all labor, materials, equipment, structural frame components and design coordination with fabricators required to provide complete porticos.

1.2 RELATED SECTIONS

Section 05120 – Structural Steel

Section 05400 – Cold-Formed Steel Framing

Section 05500 - Metal Fabrications: Supplementary supports for large items.

Section 07600 – Sheet Metal Work, General

Section 09900 - Paints and Coatings: Field painting and sealing prior to painting.

1.3 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 638	(1999) Standard Test Method for Tensile Properties of Plastics.
ASTM D 648	(1998) Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position.
ASTM D 790	(1999) Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
ASTM D 695	(1996) Standard Test Method for Compressive Properties of Rigid Plastics.
ASTM E 84	(1999) Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G, A/S

Drawings showing fabrication and installation details shall be submitted. Drawings for FRP components shall include custom profiles and dimensions, layouts for separate FRP pieces, joint locations, and details of FRP attachment to support members. Drawings shall also show layouts of metal support for FRP components including support member size and spacing and attachment details at the portico structural steel frames. Drawings shall note where field measured dimensions are required to be taken, if critical to proper installation.

SD-03 Product Data; G, A/S

Manufacturer's data sheets on each product to be used shall be submitted and shall include dimensions, finishes, storage and handling requirements and recommendations, and a complete set of manufacturer installation recommendations.

SD-04 Samples

Finish Surface and Color; G, A/S

For each custom finish specified, two samples shall be submitted. Samples shall be a minimum 150 mm square and shall represent the specified color, texture and pattern. Samples shall also include a representative example of profile relief similar to that specified.

SD-13 Certificates

Certification of Manufacturer and Installer Qualifications; G, A/S

A certificate of experience shall be submitted demonstrating that the manufacturer has a minimum 5 years of experience manufacturing FRP architectural building components that are of a similar type and scope to the specified work. The certificate shall be accompanied by a list of not less than three previous projects where the manufacturer's product(s) were installed. In addition to manufacturer qualifications, a certificate of experience shall be submitted for the FRP installer. The installer shall demonstrate a minimum 2 years of experience installing FRP systems similar to the one specified herein. The certificate shall be accompanied by a list of not less than 3 installer projects using an FRP product similar to the type specified. In lieu of demonstrated experience, the installer may submit proof that he or she is a qualified installer of an approved FRP manufacturer's product. Statement of such qualification shall come directly from the FRP manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the job site in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Transport, lift, and handle units with care, avoiding excessive stress and preventing damage; use appropriate equipment.

Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Store products in manufacturer's unopened packaging until ready for installation. Store units upright and not stacked unless permitted by manufacturer.

1.6 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.7 DESIGN VERIFICATION

Components indicated on the drawing establish the visual appearance sought and conform to the building configuration. The Contractor shall verify that all components provided fit the building's structural elements and entrance geometry. Final assembly shall conform to the visual design indicated without materially altering profiles, alignments and minimum clearances. All additional structural support, backing, sheathing and flashing shall be provided as required to complete the design.

1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of the fiber reinforced plastic fabrications with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades and coordinate FRP components with structural sub-framing.
- (4) Verification of weathertight construction.
- (5) Protection of all surfaces during and after installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GLASS FIBER REINFORCED PLASTIC (FRP) FABRICATIONS

FRP components shall be a molded surface coat over polyester resin laminate reinforced with glass fiber and structural reinforcing as required. Exposed surfaces of FRP shall be sand aggregates and colorants as required to match the specified finish. Components shall be constructed as single pieces as far as practicable and consistent with the design. For example, the entablature for the SCB entry portico may be fabricated as two separate pieces, one for the cornice and another for the pediment, but the individual cornice and pediment components shall be fabricated as one element top to bottom broken only by vertical joints between adjoining pieces. Columns may be fabricated in half sections that are joined together during field installation, but the column plinths, bases and capitals shall be a single fabrication for the full height of each column. Columns shall have proportions consistent with the Tuscan order.

2.1.1 Material Properties

Surface Coat: Ultraviolet inhibited NPG-ISO polyester gel coat, 20 mils (0.5 mm) thick, nominal. Texture on exposed faces shall be smooth.

Resin: Isophthalic polyester resin; with flame spread index less than 25, smoke developed index less than 450, when tested in accordance with ASTM E 84; heat distortion greater than 82 degrees C, when tested in accordance with ASTM D 648.

Glass Fiber: "E" type random chopped fibers.

Glass Content: 15 percent by weight, maximum.

Shell Thickness: 5 mm, minimum for entablature components, 12 mm minimum at columns. Thickness of all components shall be as recommended by manufacturer for application and load.

Surface Burning Characteristics: Flame spread index of less than 25, smoke developed index of less than 450, when tested in accordance with ASTM E 84.

2.1.2 Minimum Structural Performance

Flexural Strength: 138 MPa , when tested in accordance with ASTM D 790.

Modulus of Elasticity: 6200 MPa, when tested in accordance with ASTM D 790.

Tensile Strength: 83 MPa, when tested in accordance with ASTM D 638.

Compressive Strength: 117 MPa, when tested in accordance with ASTM D 695.

Bearing Strength: 62 MPa, when tested in accordance with ASTM D 638.

Thermal Expansion Coefficient: 5.56×10^{-6} per degree C.

Specific Gravity: 1.5.

2.1.3 Fabrication and Erection Tolerances

Variation in Thickness From Nominal: Minus 1.5 mm, plus 6 mm.

Variation in Thickness of Gel Coat: Plus and minus 2.5 mils (0.06 mm), maximum.

Variation from Dimensions Indicated on Drawings: Plus and minus 3 mm, maximum.

Variation from Square: Plus and minus 3 mm, maximum.

Variation of Hardware From Intended Location: Plus and minus 6 mm, maximum.

2.1.4 Manufacturing Requirements

All FRP components shall be factory fabricated with embedded anchorage points for a concealed attachment to the steel stud support. Embedded anchors shall be made of either galvanized or stainless steel and the style, size, gauge and spacing of the anchors shall be as designed by the manufacturer to adequately handle dead load of the panels and imposed live loads. Where necessary to field install embedded anchorage, the manufacturer's methodology for resin attachment shall be followed. Each FRP unit shall be marked with permanent serial number coordinated with shop drawing designators. All components shall be cured and cleaned prior to shipment, and any material that may be toxic to plant or animal life or incompatible with adjacent building materials shall be removed. All erection aids included in fabricated components shall be concealed in finished construction.

2.1.5 Surface Texture and Color

The finished surface texture and color of all FRP components shall be as specified on the drawings and shall be homogeneous throughout all areas of each portico.

2.1.6 Fasteners

Fasteners used to connect concealed metal attachments to steel stud and structural steel support members shall be either galvanized or stainless steel. Where necessary for field installation, fasteners used through exposed surfaces of FRP components to the steel stud support behind shall be stainless steel. All fasteners shall be of a style and size as recommended by the FRP manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

Do not begin installation until substrates have been properly constructed; verify that substrates are plumb and true. Contractor shall verify that substrate preparation is correct and ready for FRP component installation before proceeding. Check field dimensions before beginning installation. If dimensions vary from design dimensions and tolerances for proper

installation, prepare amended shop drawings indicating required revisions and resubmit for approval.

3.2 PREPARATION

Attachment surfaces shall be thoroughly cleaned prior to installation. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions. Install all supplementary temporary and permanent supports as required for proper installation.

3.3 INSTALLATION

3.1.1 General

Install in accordance with applicable building code and manufacturer's recommendations, plumb and true to line; shim where necessary. Install with variation from position shown on drawings not more than 6 mm in 3 m; align horizontal and vertical joints. Fasten using methods that allow for thermal expansion and contraction. Provide control joints at not more than 10.5 m on center if not indicated on drawings. Provide expansion joints where moving joints in substrate occur.

3.3.2 Field Repair of Seams

All fabrication seams that are not expansion joints, such as seams between column halves and any vertical seams between adjoining cornice and pediment castings, shall be field repaired utilizing the manufacturer's recommended procedures. Seams shall be blended and finished to adjacent finished FRP surfaces such that they are imperceptible from a viewing distance of 1.2 meters. The Contractor shall ensure that the sand aggregates, colorants, and any other component used in patching seams are an exact match to those used in fabrication of the FRP panels. Any field-applied fasteners that are exposed to view shall be countersunk and patched utilizing the seam repair methodology.

3.4 PROTECTION

Protect installed products until completion of project. Provide padded guards at all areas subject to contact from pedestrians or equipment. Touch-up, repair or replace damaged products as determined by contracting Officer.

END OF SECTION

SECTION 06650

SOLID POLYMER FABRICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-60003	Partitions, Toilet, Complete
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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

A136.1-1967	Organic Adhesives for Installation of Ceramic Tile
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Z124-1980	Plumbing
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D256-84	Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials
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D570-81	Test Method for Water Absorption of Plastics
---------	--

D638-84	Test Method for Tensile Properties of Plastics
---------	--

D696-79	Test Method for Coefficient of Linear Thermal Expansion of Plastics
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D1499-84	Recommended Practice for Operating Light-and-Water Exposure Apparatus (Carbon-Arc Type) for Exposure of Plastics
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E84-84a	Test Method for Surface Burning Characteristics of Building Materials
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

LD3-1980	High Pressure Decorative Laminates
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1.2 SCOPE

Work in this section includes tub/shower wall surrounds at Barracks Room Module baths and miscellaneous wall cladding, counter tops and window sills.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; GA, A/S

Drawings showing plans, elevations, details of construction, joint form and sealant, fittings, mountings, and anchorage.

SD-03 Product Data

Solid Polymer Fabrications; GA, A/S

Manufacturer's technical data and catalog cuts including fabrication information, product performance and installation and cleaning instructions.

SD-04 Samples

Solid Polymer Fabrications; GA, A/S

Manufacturer's standard color charts and color samples.

1.4 DELIVERY, STORAGE, AND HANDLING

Do not deliver materials until all surfaces to receive solid polymer are ready for installation. Components shall be delivered to the job site in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling. Provide coverings to prevent physical damage or staining following installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that provide all material and labor necessary for replacement of defective materials for a period of 10 years.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of solid polymer fabrications with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.

- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Installation at wet areas provides a complete water tight seal.
- (5) All finishes and colors are as indicated.
- (6) Installed materials are protected from damage.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 SOLID POLYMER PROPERTIES

Components shall be cast, filled acrylic, not coated, laminated or of composite construction, meeting ANSI Z124-1980 and FS WW-P-541E/GEN. Material shall have minimum physical and performance properties specified.

Composition of material and integral color(s) shall permit superficial damage to a depth of 1 mm to be repairable by sanding or polishing. Materials shall be provided in the minimum sheet sizes required to accomplish the installations as detailed without additional seams or splices.

2.2 PERFORMANCE CHARACTERISTICS

<u>PROPERTY</u>	<u>REQUIREMENT</u> (min. or max.)	<u>TEST PROCEDURE</u>
Tensile Strength	5000 psi min	ASTM D638
Tensile Modulus	1.0×10^6 psi min	ASTM D638
Flexural Strength	7000 psi min	ASTM D790
Flexural Modulus	1.2×10^6 psi min	ASTM D790
Elongation	0.4% min.	ASTM D638
Hardness	90-Rockwell "M" scale min. 52-Barcol Impressor min.	ASTM D758 ASTM D2583
Thermal Expansion	3.5×10^{-6} in/in/deg C. max.	ASTM D696
Color Stability	No change, 100 hours min.	NEMA LD3-3.10
Wear and Cleanability	Passes	ANSI Z124.3
Abrasion Resistance	No loss of pattern max. weight loss (1000 cycles)=0.9g.	NEMA LD3-3.01 ANSI Z124.3

<u>PROPERTY</u>	<u>REQUIREMENT</u>	<u>TEST PROCEDURE</u>
Boiling water Surface Resistance	No Change	NEMA LD3-3.05
Izod Impact (NOTCHED SPECIMEN)	0.28 ft.-lbs/in. of notch	ASTM-D-256
Impact Resistance (Sheet)	No fracture - .5 lb ball (1/4" slab – 36" drop)	NEMA-LD-3-3.3
Water Absorption	Long Term 0.8% (1/4")	ASTM-D-570
Flammability (Class I)		
Flame Spread	< 26	
Smoke Developed	< 30	
Volatile Organic Content	0.0% (at room temperature)	

2.3 ACCESSORIES

2.3.1 Joint Adhesive

Joint adhesive shall be two-part adhesive kit to create inconspicuous, non-porous joints by chemical bond. Adhesive shall be as recommended in writing by the solid polymer manufacturer for use in the intended application.

2.3.2 Panel Adhesive

Panel adhesive shall be neoprene based panel adhesive meeting ANSI A136.1, Underwriter's Laboratories (UL) listed. Adhesive shall be as recommended in writing by the solid polymer manufacturer for use in the intended application.

2.3.3 Sealant

Sealant shall be mildew-resistant, FDA and UL listed silicone sealant in colors matching components. Sealant shall be as recommended in writing by the solid polymer manufacturer for use in the intended application.

2.3.4 Conductive Tape

Conductive tape shall be manufacturer's standard foil tape, 4 mils thick, applied around the edges of cutouts containing hot or cold appliances.

2.3.5 Insulating Felt Tape

Insulating tape shall be manufacturer's standard product for use with conductive tape to insulate solid polymer surfaces from hot or cold appliances.

2.4 TUB/SHOWER SURROUNDS

Tub/shower surrounds shall consist of four 6 mm thick, full height panels with vertical edge, corner and ceiling trim strips, adhesively applied to cementitious backer board using thin-set neoprene based panel adhesive or Type 1 ANSI A 136.1-1967 solvent based adhesive. Layout of surround shall be as indicated on drawings. All sheets shall be full height, with no horizontal seams. Long wall of surround shall be fabricated of two panels with a vertical reverse batten seam. Batten shall be recessed into a notch in the backer board. Panel edges shall have 12 mm running trim. Interior corner trim shall be fabricated with 50-mm radius, lapped corners. All components shall be solid polymer.

2.5 Countertops (CQ Desk and Laundry Room)

Counter tops shall be 12 mm thick polymer material. Edge details shall be as indicated on the drawings. Counter tops shall be complete with 100 mm high by 12-mm thick backsplash at laundry room. Seam between counter top and adjacent walls shall be sealed with silicone sealant. Color of counter tops and splashes shall be as indicated on drawings.

2.6 WALL CLADDING

Wall cladding/wainscoting with flexible joints shall be 6 mm thick, with 3 mm wide joints every 1500 mm sealed with manufacturer's silicone sealant matching polymer material color. Wall cladding/wainscoting shall be adhesively applied to solid substrates. Wall cladding/wainscoting shall be color as indicated on drawings.

Wall cladding/wainscoting with hard seams shall be 6 mm thick, with butt joints between sheets made with joint adhesive. 3 mm silicone filled expansion joints shall be provided every 3 000 to 4 500 mm. Wall cladding/wainscoting shall be attached to solid substrate using silicone sealant. Wall cladding/wainscoting shall be color as indicated on drawings.

2.7 WINDOW SILLS (BARRACKS ROOM MODULES AND CORRIDORS)

Window sills shall be 12-mm thick polymer material, adhesively joined to substrate without seams, having edge details as indicated on the drawings. Window sills shall be color as indicated on drawings.

2.8 COLORS

Colors shall be from manufacturer's standard solid polymer selection. All exposed sealants used shall be selected from polymer manufacturer's color coordinating products.

2.9 FABRICATION

2.9.1 Fabrication

Components shall be factory fabricated to the greatest extent practical to sizes and shapes indicated, in accordance with approved Shop Drawings. Joints shall be formed between components using manufacturer's standard joint adhesive. Joints shall be reinforced with 2-inch wide batten strips of solid polymer material. Face seams between polymer sheets shall be smooth, inconspicuous, "hairline" type. Factory cutouts shall be provided for plumbing fittings and bath accessories as indicated on the Drawings. Component edges shall be cut

and finished with clean, sharp returns. Contours and radii shall be routed to template, with edges smooth. Defective and inaccurate work shall be rejected. Inlay work shall be performed in accordance with manufacturer's product data, using acrylic or methacrylate inlay material and color indicated on the Drawings.

2.9.2 Surface Finish

Finished surfaces shall be uniform in character and free of surface distortion, pits, cracks, crazing or abrasions. Finish of components shall be as follows:

Tub/Shower Surrounds	Matte finish with a gloss range of 5-20
Countertops	Polished finish with a gloss range of 50-80
Wall Cladding	Matte finish with a gloss range of 5-20
Cladding Trim	Semi-gloss finish with a gloss range of 20-50
Window Sills	Polished finish with a gloss range of 50-80

2.9.3 Thermoforming

Thermoforming shall comply with manufacturer's product data. Molds shall be constructed of plywood in "male/female" sections matching component shapes. Component parts shall be shaped prior to joining and finishing. Pieces shall be cut to finished dimensions with edges sanded and nicks and scratches removed. Heat the entire component uniformly between 275-325 degrees Fahrenheit during forming. Prevent blistering, whitening and cracking of solid polymer material during forming. Defective material shall be rejected.

2.9.4 Surface Inlays

Color inlay shall comply with manufacturer's product data. Groove for inlay shall be routed to straight edge or pattern indicated on the Drawings with groove completely filled to overflowing, without air bubbles or voids, using bulk acrylic material furnished by polymer manufacturer. Inlay shall be sanded, finished, and touched up for uniform appearance.

Material inlay shall comply with manufacturer's product data, using material and finish as shown on the Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Components shall be installed plumb, level and rigid. Field joints shall be made using specified adhesives, with joints inconspicuous in the finished work. Tub/shower surrounds shall be constructed and installed in full compliance with the manufacturer's written instructions for wet wall systems. Back splashes shall be mounted as indicated on the drawings. Splashes shall be adhered using color matched silicone sealant. Where tub/shower surround abuts the bath tub use care to verify that silicone sealant seam is

installed full depth, with a solid, smooth coved surface to ensure positive drainage and eliminate potential wicking of water between the surface sheet and the substrate.

3.1.2 Coordination

Openings and offsets in solid polymer components as required for plumbing fixtures, toilet accessories, hardware, miscellaneous mechanical or electrical systems components and other adjacent parts of the work shall be coordinated, cut and prepared in the shop to the maximum extent possible.

3.2 SURFACE FINISH

Final surface finishing of all solid polymer materials shall be as indicated in writing by the manufacturer. Surfaces shall be orbital sanded using appropriate sanding film for the designated finish. Buff all surfaces following standing and wipe clean. Utilize compounding and/or finishing liquids as indicated for final surface preparation.

3.3 CLEANING

Components shall be cleaned after installation and covered to protect against damage during completion of the remaining project items. Components damaged after installation by other trades will be repaired or replaced.

END OF SECTION

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SECTION 07110

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 41	(1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing
ASTM D 1187	(1997) Asphalt-Base Emulsions for Use as Protective Coatings for Metal
ASTM D 1227	(1995) Emulsified Asphalt Used as a Protective Coating for Roofing
ASTM D 4479	(1993) Asphalt Roof Coatings - Asbestos Free

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-07 Certificates

Materials; G

Certificates attesting that the materials meet the requirements specified.

1.3 QUALIFICATIONS

Work shall be performed by skilled laborers thoroughly experienced in the type of bituminous dampproofing work specified to meet the requirements of the contract.

1.4 DELIVERY, STORAGE AND HANDLING

Dampproofing materials shall be delivered to the project site in the original sealed containers bearing the name of manufacturer, contents and brand name, and stored in a weathertight enclosure to prevent moisture damage and absorption. Dampproofing materials shall be protected from freezing. Asphalt shall be stored off the ground on pallets, and covered on top and all sides with breathable-type canvas tarpaulins. Plastic sheets cause condensation buildup; and therefore, shall not be used to cover dampproofing materials. Care shall be

taken during storage to avoid separation or settlement of the emulsion components. Damaged or deteriorated materials shall be removed from the project site.

1.5 SCHEDULING

Dampproofing of foundation walls shall be scheduled so that curing will be accomplished prior to backfilling and so that backfilling will be accomplished as soon as possible after curing.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance bituminous dampproofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Protection of adjacent surfaces from contamination with dampproofing products.
- (4) Limitation of dampproofing application to only those surfaces concealed from view in finished construction.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 EMULSION-BASED ASPHALT DAMPPROOFING

2.1.1 Fibrated Emulsion-Based Asphalt

Fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1227 Type IV, asbestos-free, manufactured of refined asphalt, emulsifiers and selected clay, fibrated with mineral fibers. For spray or brush application, emulsion shall contain a minimum of 59 percent solids by weight, 56 percent solids by volume. For trowel application, emulsion shall contain a minimum of 58 percent solids by weight, 55 percent solids by volume.

2.1.2 Non-Fibrated Emulsion-Based Asphalt

Non-fibrated emulsion-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 1187 Type II or ASTM D 1227 Type III, manufactured of refined asphalt, emulsifiers and selected clay. Asphalt shall contain a minimum 58 percent solids by weight, 55 percent solids by volume.

2.2 SOLVENT-BASED ASPHALT DAMPPROOFING

2.2.1 Asphaltic Primer

Primer for cold-applied solvent-based asphalt dampproofing shall conform to ASTM D 41, asbestos-free, non-fibrated, manufactured with highly ductile soft asphalts and selected hydrocarbons.

2.2.2 Fibrated Asphalt

Fibrated solvent-based asphalt dampproofing shall be cold-applied type conforming to ASTM D 4479 Type I, asbestos-free, manufactured with selected asphalts, stabilizers, mineral spirits and fibrated with mineral fibers. Solvent-based asphalt shall contain 72 percent solids by weight, 65 percent solids by volume.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surfaces scheduled for bituminous dampproofing shall be prepared in accordance with dampproofing manufacturer's recommendations. Surface preparation shall be approved prior to dampproofing application.

3.1.1 Protection of Surrounding Areas

Before starting the dampproofing work, the surrounding areas and surfaces shall be protected from spillage and migration of asphalt onto other work. Drains and conductors shall be protected from clogging with asphalt.

3.1.2 Masonry Surfaces

Surfaces shall be free of oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Mortar joints shall be flush and free of extraneous mortar and chipped or broken masonry. Masonry shall be surface dry at time of application.

3.1.3 Concrete Surfaces

Surfaces shall be properly cured, free of form release agents, oil, grease, dirt, laitance, loose material, frost, debris and other contaminants. Form ties shall be cut flush with surface. Sharp protrusions and form match lines shall be removed. Holes, voids, spalled areas and cracks which can damage the dampproofing materials and impair performance shall be repaired. Rough surfaces shall be parged with a well-adhering coat of cement mortar. Concrete shall be surface dry at time of application.

3.1.4 Metal Surfaces

Metal surfaces shall be dry and be free of rust, scale, loose paint, oil, grease, dirt, frost and debris.

3.2 APPLICATION OF BITUMINOUS DAMPPROOFING

Dampproofing shall be applied after the priming coat is dry, but prior to deterioration of the primed surface. Apply two coats of dampproofing. The initial coat shall be applied by brush to form complete bond with primer. Second coat shall be applied with brush or sprayed. Recoat all porous spots.

3.2.1 Emulsion-Based Asphalt

Emulsion-based asphalt dampproofing work shall not be performed in temperatures below 4 degrees C. Emulsions shall have a smooth and uniform consistency at time of application. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film of not less than 0.3 mm (12 mils) thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

- a. Primer: 0.2 liters per square meter (1/2 gallon per 100 square feet), cold-applied.
- b. Fibrated Dampproofing: 0.8 liters per square meter, cold-applied with spray, brush or trowel.
- c. Non-fibrated Dampproofing: 0.8 liters per square meter, cold-applied with spray, brush or trowel.

3.2.2 Solvent-Based Asphalt

Solvent-based asphalt dampproofing work shall not be performed in temperatures below 4 degrees C. Dampproofing materials shall be applied in accordance with manufacturer's published instructions to produce a smooth uniform dry film not less than 0.3 mm (12 mils) thick without voids or defects. Dull or porous spots shall be recoated. Dampproofing materials shall seal tightly around pipes and other items projecting through dampproofing. Rates of application shall be as follows:

- a. Primer: 0.4 liters per square meter, cold-applied.
- b. Dampproofing Coat: 0.8 liters per square meter, cold-applied with spray, brush or trowel.

3.3 CLEAN-UP

Surfaces of other work which are stained with dampproofing materials shall be cleaned with a cleaner recommended by dampproofing manufacturer.

3.4 PROTECTION

The completed dampproofing work shall be protected from damage during and after construction.

END OF SECTION

SECTION 07131

ELASTOMERIC MEMBRANE WATERPROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1993; R 1998) Rubber Products - Chemical Analysis
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 471	(1998e1) Rubber Property - Effect of Liquids
ASTM D 624	(1991; R 1998) Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1171	(1999) Rubber Deterioration - Surface Ozone Cracking Outdoors or Chamber (Triangular Specimen)
ASTM D 4637	(1996) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM G 21	(1996) Determining Resistance of Synthetic Polymeric Materials to Fungi

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Installation; G

Manufacturer's instructions for installation of the elastomeric membrane, including procedures for preparing the membrane for use, flashing, and splicing. Instructions shall include recommended or required protective covering and procedures for safe handling and use of cleaners, adhesives, and sealants.

SD-07 Certificates

Materials; G

Certificates of compliance attesting that the materials meet specification requirements. Certificates may show qualification of the identical compound in the specified test.

1.3 DELIVERY, STORAGE, AND HANDLING

Materials shall be delivered to the job site in unopened containers bearing the manufacturer's name, brand name, and description of contents. Membrane, flashing, and adhesives shall be stored in clean, dry areas. Storage temperature for adhesives shall be between 16 and 27 degrees C. Protection board shall be stored flat and off the ground.

1.4 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of elastomeric membrane waterproofing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Coordination of membrane installation following completion of all work that penetrates the membrane.
- (4) Verification of waterproof assembly with leakage tests.
- (5) Protection of membrane from other construction activity following completion.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Adhesives, mastics, cements, tapes, and primers shall be as recommended by the membrane manufacturer and shall be compatible with the material to which they are to be bonded.

2.1.1 General Performance Requirements

All membranes shall meet the following requirements when tested by the referenced ASTM standards:

ASTM E 154 Puncture Resistance	178 N (40 pounds), (min.)
ASTM E 96, Procedure B Water Vapor Transmission at 27 degrees C Permeance	14.4 ng per Pa per sec per sq. meter (0.25 perms), (max.)
ASTM G 21 or ASTM E 154 Resistance to Soil Bacteria or Fungi	No sustained growth or discoloration after 21 days

Membrane(s) used shall be selected from the following based on function and degree of atmospheric exposure and the membrane manufacturer's written recommendations.

2.1.1.1 Butyl Rubber

Thickness, plus or minus 10 percent	1.5 mm
ASTM D 297 Specific Gravity	1.2 plus or minus 0.05
ASTM D 412 Tensile Strength	8275 kPa (1200 psi) (min.)
ASTM D 624 Elongation	300 percent (min.)
ASTM D 624 Tear Resistance	21 900 Newtons per m (125 lb./inch) (min.)
ASTM D 471 Water Absorption 168 hours @ 40 degrees C	plus 2 percent (max.)
ASTM D 1171 Ozone Resistance 50 pphm in air 100 hours @ 40 degrees C	20 percent

2.1.1.3 Composite Self-Adhering Membrane

Membrane shall be a polymeric sheeting integrally bonded to rubberized asphalt with a minimum thickness of 1.5 mm. 60 mils.

2.1.1.4 Chlorinated Polyethylene (CPE) Sheeting

Membrane shall be uncured chlorinated polyethylene, synthetic elastomeric sheeting of 1 mm nominal thickness.

2.1.1.5 Chloroprene

Chloroprene membrane shall conform to ASTM D 4637, Type II, Grade 1, Class U, 1.5 mm minimum thickness.

2.1.2 Protection Board

Protection board for waterproofing membrane shall be 13 mm minimum asphalt plank, 25 mm thick polystyrene foam insulation or premolded bituminous protection board; 3 mm thick for vertical surfaces, and 6 mm thick for horizontal surfaces. Protection board selected shall be as recommended in writing by the membrane manufacturer. Verify compatibility.

2.2 ACCESSORIES

Flashing, counterflashing, expansion joint covers and corner fillets shall be as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Surfaces to which waterproofing is to be applied shall be clean, smooth, and free from deleterious materials and projections. Holes, honeycomb, cracks, or cavities shall be pointed or filled and finished flush with Portland cement mortar. Top surfaces of projecting masonry or concrete ledges below grade, except footings, shall be beveled. Before waterproofing is applied, the surfaces to be covered shall be swept to remove all dust and foreign matter. Concrete surfaces shall be cured 30 days prior to receiving elastomeric waterproofing and shall not be cured with compounds containing wax or oil. Masonry surfaces to be waterproofed shall have joints struck flush.

3.2 APPLICATION

Waterproofing shall not be applied to wet surfaces. The ambient and surface temperatures shall be above 4.5 degrees C during application. Membrane under slabs shall be carried up abutting vertical surfaces to the level of finish of floor or to within 13 mm of the top edge of base where base is shown and cemented solid to the substrate. Membrane shall not be continuous through walls, floors, piers, and columns unless otherwise shown. Concrete surfaces shall be primed to receive the membrane. Membranes shall be handled and installed in accordance with the approved installation instructions. Primers, adhesives, and mastics shall be applied in accordance with the membrane manufacturer's printed instructions. Laps shall be oriented so that water will flow over the lap, and not into them. As soon as the mastic is fully set and dry, joints shall be checked. Where any openings or fishmouths appear, joints shall be resealed and rerolled. Wrinkles and buckles shall be avoided in applying membrane and joint reinforcement. Nonadhering membranes shall be unrolled and allowed to remain flat for at least 2 hours before application. Membranes shall

be drawn tight during installation without stretching. Self-adhering membrane shall be installed by removing the release sheets on the back of the membrane and applying the tacky surface onto the primed surface. Laps and splices shall be sealed prior to completion of a day's work.

3.2.1 Butyl Rubber Installation

Each sheet shall be lapped at sides and ends a minimum of 150 mm over the preceding sheet. Lap and splice areas of membrane shall be cleaned with heptane, hexane, or white gasoline. Unvulcanized compounded butyl tape, 150 mm wide shall be applied between lapped splices so that the tape extends approximately 6 mm beyond the exposed sheeting edge. The tape shall be rolled firmly into place as it is applied. Tape backing shall be removed and the lapped sheeting rolled or pressed into place. Splicing adhesive shall be applied to the lapped area 90 mm on either side of the lapped edge. The splice adhesive shall be allowed to dry thoroughly and the lap reinforced with 150 mm wide unvulcanized compounded butyl tape. Full contact shall be made for all lap areas. Corner splices and flashing overlaps shall be reinforced with a 300 mm wide strip of membrane over one layer of butyl tape or with a prefabricated corner of butyl rubber.

3.2.2 Composite Self-Adhering Membrane Installation

On vertical surfaces, membrane shall be applied in lengths up to 2400 mm starting at the bottom. Each sheet shall be lapped at edges and ends a minimum of 65 mm over the preceding sheets. The membrane shall be rolled to adhere with the substrate. Corners and joints shall be double-covered by first applying a 300 mm width of membrane centered along the corner or joint. Inside and outside corners shall then be covered with membrane. Exposed termination edges of membrane on horizontal or vertical surfaces shall be finished with a trowelled bead of mastic. Mastic shall be applied around termination edges of membrane and around drains and projections. Mastic shall be applied at the termination of each day's work.

3.2.3 Chlorinated Polyethylene (CPE) Sheeting Installation

Sheets shall be lapped at edges and ends a minimum of 65 mm over the preceding sheet. All horizontal membranes shall overlap vertical surfaces by at least 75 mm.

3.2.4 Chloroprene Rubber Sheeting

Each sheet shall overlap the previously installed sheet by a minimum of 75 mm. Sheet shall be folded lengthwise to expose one half of the underside of the sheet for cleaning the sheet with cleaner recommended by the manufacturer. Adhesive shall be applied to sheet and substrate. Two coats of adhesive are required on the substrate with 1/2 hour between coats. Sheet shall not be bonded to substrate until adhesive does not come off at a dry finger touch. Chalk lines or masking tape shall be used as guides for adhesive application and positioning sheets. After adhesive has dried, sheet shall be folded back onto the substrate or previously applied sheet membrane. Membrane shall be rolled to obtain complete adhesion. The exposed edge of each sheet shall be further sealed with a fillet-shaped bead of adhesive, tooled to obtain positive contact with the surface of both sheets.

3.3 TESTS

When required, and after the system is cured, the membranes on horizontal surfaces shall be tested by flooding the entire waterproofed area with a minimum of 50 mm head of water for a period of 24 hours. There shall be no water added after the start of the period. Water level shall be measured at the beginning and at the end of the 24 hour period. If the water level falls, remove the water and inspect the waterproofing membrane. Leak sites shall be marked, dried and repaired, and the test shall be repeated.

3.4 PROTECTION

Horizontal applications of membrane shall be protected from traffic during installation. No equipment shall be allowed directly on the membrane. Plywood, or similar material, overlayment shall be provided for wheel-ways. Walkways shall be provided where heavy traffic from other trades is expected. Materials shall not be stored on the membrane. A protective covering shall be installed over the membrane immediately after installation or testing. If membrane is to be exposed, a temporary covering shall be applied to protect the membrane until the protection board is installed.

3.4.1 Projections

Projections passing through membrane shall be flashed as recommended by the manufacturer of the waterproofing membrane.

3.4.2 Counterflashing

Waterproofing connecting with work exposed to the weather shall be counterflashed to form a watertight connection. Upper edge of membrane waterproofing and protective covering shall be counterflashed.

3.4.3 Expansion Joints and Fillets

Expansion joints and corner fillets shall be installed as recommended by the manufacturer of the waterproofing membrane.

3.4.4 Vertical Membrane Waterproofing

Waterproofing shall be protected with a 13 mm asphalt-impregnated fiberboard [25 mm polystyrene foam insulation or 3 mm compatible water-resistant (bitumen type) protection board as recommended by the membrane manufacturer. Edges of protection shall be butted, and exposed surfaces shall be covered by a coating of bitumen.

3.4.5 Horizontal Membrane Waterproofing

Waterproofing shall be covered with Portland cement mortar not less than 20 mm thick, uniformly placed, and allowed to set before subsequent construction is installed.

END OF SECTION

SECTION 07210

BUILDING INSULATION

PART 1 GENERAL

1.1 RELATED SECTIONS

Refer to SECTION: NON-BEARING MASONRY VENEER/STEEL STUD WALLS and SECTION: EXTERIOR INSULATION AND FINISH SYSTEM for additional information related to insulation in those exterior wall systems. Refer to SECTION: ROOF INSULATION for all insulation associated with roofing systems.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1999) Particleboard Mat Formed Woods

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208	(1995) Cellulosic Fiber Insulating Board
ASTM C 516	(1980; R 1996e1) Vermiculite Loose Fill Thermal Insulation
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties By Means of the Heat Flow Meter Apparatus
ASTM C 549	(1981; R 1995e1) Perlite Loose Fill Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 612	(2000) Mineral Fiber Block and Board Thermal Insulation

ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 726	(2000) Mineral Fiber Roof Insulation Board
ASTM C 728	(1997) Perlite Thermal Insulation Board
ASTM C 739	(2000) Cellulosic Fiber (Wood-Base) Loose-Fill Thermal Insulation
ASTM C 764	(1999) Mineral Fiber Loose-Fill Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1289	(1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
ASTM D 2863	(2000) Test Method for Measuring the Minimum Oxygen Concentration to Support Candle-like Combustion of Plastics (Oxygen Index)
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 90	(2000) Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 96	(2000) Water Vapor Transmission of Materials
ASTM E 154	(1988; R 1999) Water Vapor Retarders Used in Contact with Earth Under Concrete Slabs, on Walls, or as Ground Cover
ASTM E 283	(2000) Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Differences Across the Specimen.

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
FM P7825c	(1998) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bldg Mat Dir	(1999) Building Materials Directory
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1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Application of Insulation; G

Insulation manufacturer's recommendations for the application and installation of insulation.

Inspection;

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-07 Certificates

Insulation; G

Certificate attesting that the perlite, glass and mineral fiber, polystyrene, polyurethane, or polyisocyanurate insulation furnished for the project contains recovered material, and showing an estimated percent of such recovered material.

1.4 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, vapor barrier and moisture barrier shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation shall not be used and shall be permanently removed from the site. For 24 hours immediately prior to installation, all materials shall be maintained at a temperature above 10 degrees C. Polystyrene insulation shall be stored away from areas where welding is being performed or where contact with open flames is possible.

1.5 FIRE CLASSIFICATION

Insulation used in rated wall or ceiling assemblies shall be mineral wool, have been tested for fire resistive performance and shall be listed as non-combustible, per ASTM C 136. Flame spread rating shall be 5 or less and smoke developed of 0 per ASTM E 84.

1.6 PROJECT CONDITIONS

Verify completion status of all construction adjacent to areas to receive insulation. Do not begin insulation or vapor barrier installation until all work to be concealed is completed. Coordinate work of related trades to ensure proper location of all systems intersecting insulation.

1.7 ENVIRONMENTAL REQUIREMENTS

Polyicynene spray insulation shall not contain any urea-formaldehyde, nor shall any products or equipment requiring the use of CFC's or HCFC's be permitted either in the product itself or the application process.

1.8 MOCK UP

Prepare a mock up of polyicynene spray insulation on the exterior walls of one corner room module in a barrack. Mock up shall demonstrate appropriate installation practice and verify adhesion of insulation to substrate materials. Following acceptance by the contracting officer, the mock up shall remain visible for the remainder of the application period to serve as a quality standard. Mock up may remain as part of the finished construction.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of building insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- 1) Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- 2) Storage and handling of materials.
- 3) Inspection of material delivered to the project site against approved material data.
- 4) Insulation meets all requirements for shape, size, strength, fire resistance and acoustic performance, etc.
- 5) Shop drawings include explicit identification of coordination with other trades.
- 6) Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- 7) Insulation and vapor barriers are protected following installation until protected by finished construction.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 BITUMINOUS MATERIALS

Bituminous materials may be used for attachment of perimeter insulation to foundation walls. Bituminous materials used as adhesive shall not deleteriously affect the insulation, and shall have a record of satisfactory and proven performance for the conditions used. Polystyrene

insulation shall be faced with insulation manufacturer's recommended separation sheet for asphalt. Bituminous materials shall conform to the following requirements:

2.1.1 Asphalt Bitumen

ASTM D 312, Type III or IV. Asphalt flash point, finished blowing temperature, and equiviscous temperature (EVT) for mop and for mechanical spreader application shall be indicated on bills of lading or on individual containers.

2.1.2 Asphalt Cement

ASTM D 4586, Type I for surfaces sloped from 0 to 250 mm per meter 3 inches per foot; Type II for slopes greater than 250 mm per meter 3 inches per foot.

2.1.3 Asphalt Primer

ASTM D 41.

2.2 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value, and the thickness. Identification shall be on individual pieces or individual packages. Thermal resistance of insulation shall be not less than the R-values shown. R-values shall be determined at 24 degrees C in accordance with ASTM C 518. Minimum thickness shall be as recommended by the manufacturer.

The insulation manufacturing process shall not include chlorofluorocarbons (CFC) or formaldehydes. Insulation and fiberboard shall conform to EPA requirements in conformance with SECTION: RECYCLED / RECOVERED MATERIALS. Materials containing more than one percent asbestos will not be allowed. Insulation shall be a combination of the following materials, as specified or indicated on drawings:

2.2.1 Batt or Blanket

2.2.1.1 Glass Fiber Batts and Rolls (Thermal Batts)

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, Class A, having a UL flame spread rating of 10 and a smoke developed rating of 100 or less when tested in accordance with ASTM E 84. Width and length shall suit construction conditions. Minimum R value of 19.

Typical Locations: Exterior stud walls (Company and Battalion Buildings), brick veneer and EIFS clad.

2.2.1.2 Glass Fiber Batts and Rolls (Sound Attenuation Batts)

Glass fiber batts and rolls shall conform to ASTM C 665, Type I unfaced insulation, and ASTM E 136. Material shall be Class A, having a UL flame spread rating of 10 and a smoke developed rating of 100 or less when tested in accordance with ASTM E 84. Acoustic

performance shall test an NRC value of 1.0 minimum for a nominal 90 mm thick batt. Width and length shall suit construction conditions. Thickness as indicated.

Typical Locations: Interior, non-fire rated, stud walls where increased sound control is required.

Suspended ceilings in barracks room modules.

2.2.1.3 Mineral Wool Batt (Sound Attenuation Fire Batts)

Mineral wool batt shall conform to ASTM C 665, Type I unfaced insulation and shall be non-combustible by ASTM C 136. Material shall be Class A, having a UL flame spread rating of 10 and a smoke developed rating of 100 or less when tested in accordance with ASTM E 84. Acoustic performance shall test a NRC value of 1.0 minimum for a nominal 65 mm thick batt. Width and length shall suit construction conditions. Thickness as indicated.

Typical Locations: Interior, fire rated walls, and corridor ceilings in barracks.

2.2.1.4 Mineral Wool (Safing Insulation)

Mineral wool batt shall conform to ASTM C 665, Type I unfaced insulation and shall be non-combustible by ASTM C 136. Material shall be Class A, having a UL flame spread rating of 10 and a smoke developed rating of 100 or less when tested in accordance with ASTM E 84. Width and length shall suit construction conditions. Thickness as required.

Typical locations: Voids in elevated concrete floor slabs and at edge of slab and exterior wall construction; gaps, voids and penetrations in fire rated walls.

2.2.3 Sill Sealer

Mineral wool, 25 mm thick and compressible to 0.8 mm, 1/32 inch, width of sill, designed to perform as an air, dirt, and insect seal in conformance with ASTM C 665, Type I. Provide at exterior walls.

2.2.4 Rigid Insulation (Perimeter Foundation and Under Slab)

Minimum R value of 11. Extent of insulation as indicated on drawings.

2.2.4.1 Polystyrene Board

Polystyrene board shall be extruded and conform to ASTM C 578, Type IV. Nominal R value of 5 for 25 mm thick section. Maximum water absorption of 0.7 percent by volume when tested according to ASTM C 272.

2.2.4.2 Mineral Fiber Block and Board

Mineral fiber block and board shall conform to ASTM C 612 or ASTM C 726 with a minimum recovered material content of 5 percent by weight of mineral fiber core material.

2.2.4.3 Cellular Glass

Cellular glass shall conform to ASTM C 552.

2.2.5 Polyisocyanurate Spray Insulation (Barracks and SCB exterior walls)

Polyisocyanurate spray insulation shall be hydrophobic, low-density, open-cell modified polyisocyanurate, conforming to the following standards:

- 2.2.5.1 Thermal Resistance: ASTM C518, 3.6 (R-value per inch)
- 2.2.5.2 Air Permeance: ASTM E283 (for 133 mm of material) 0.0049 l/sm/second
- 2.2.5.3 Water Vapor Transmission: ASTM E 96 (for 127 mm of material) 10 perms
- 2.2.5.4 Sound Transmission Class (STC): ASTM E 90 STC 37 in wood stud wall
- 2.2.5.5 Noise Reduction Coefficient (NRC): ASTM E 90, NRC 0.7 in wood stud wall
- 2.2.5.6 Corrosion: No significant corrosion when in contact with steel under 85 percent relative humidity.
- 2.2.5.7 Bacterial or Fungal Growth: No growth and no material deterioration.
- 2.2.5.8 Flame Spread and Smoke Development Rating: ASTM E 84, flame < 20 and smoke < 400.
- 2.2.5.9 Fuel Contribution: ASTM E 84, 0.
- 2.2.5.10 Oxygen Index: ASTM D 2863, average value of 23.1 percent.
- 2.2.5.11 Use Restrictions

Polyisocyanurate insulation shall not be installed below grade, in contact with water or within 50 mm of heat emitting devices where the temperature is in excess of 93 degrees C. Polyisocyanurate is never acceptable as an interior finish and must always be concealed by finished construction. A separate, continuous vapor retarder shall separate the insulation from all interior spaces.

2.3 VAPOR RETARDER

Vapor retarder shall be polyethylene sheeting conforming to ASTM E 154 or other equivalent material. Thickness shall be 6 mils. Vapor retarder shall have a maximum vapor permeance rating of 29 ng per Pa per second per square meter (0.5 perms) 0.5 perms as determined in accordance with ASTM E 96, unless otherwise specified.

2.4 FASTENERS AND RETAINERS

Friction fit insulation between studs and lay-in insulation in concealed ceiling spaces is acceptable. Fasteners and retainers, where required, shall be specifically designed to hold insulation securely in place. Fasteners shall be of the size and type necessary to hold

insulation adequately and provide a neat appearance. Metallic components shall be nonferrous or have a corrosion resistant coating. Fasteners and retainers shall not pose a risk of penetration to vapor barriers in exterior walls.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation shall be coordinated with adjacent construction to ensure that insulation and vapor retarder remains undisturbed once placed. Placement of insulation and vapor retarder shall be closely followed by installation of gypsum wallboard or other wall finish material. All surfaces shall be free from ice, frost and surface moisture and shall be smooth, firm, free from dirt, projections and foreign materials. Vents and other items penetrating the walls shall be secured in position and properly prepared for flashing. Surfaces shall be inspected and approved prior to application of insulation.

3.2 THICKNESS OF INSULATION

Drawings shall not be scaled to determine the required thickness of insulation. Actual installed thickness of insulation shall be such as to provide the R-values indicated. For acoustical insulation the installed thickness shall be as shown. Polyisocyanurate spray insulation shall be applied to fill wall cavities completely and finished flush with interior face of studs. Polyisocyanurate spray insulation shall be applied to attain a thickness of 1 inch on the bottom of all steel floor decks.

3.3 ENVIRONMENTAL CONDITIONS

The temperature of insulating materials shall be as required by the manufacturer. Interior air temperature and humidity level shall also be as recommended by insulation manufacturer.

3.4 INSTALLATION OF INSULATION

Insulation shall be installed after construction has advanced to a point that the installed insulation will not be damaged by remaining work. Insulation shall be installed on the exterior side of such items as electrical boxes and water lines. Unless otherwise specified, installation shall be in accordance with the manufacturer's recommendation.

3.4.1 Perimeter Insulation

Insulation shall be applied in one layer as shown on drawings. Insulation placed directly against foundation walls shall be applied with adhesives as recommended by the manufacturer to hold it in place. When backfilling, care shall be exercised to ensure that the insulation remains in place and is undamaged. Insulation shall be placed to extend continuously from the top of the footing to the bottom of the floor slab.

3.4.2 Stud Wall Insulation

Insulation shall be installed between framing members. Insulation shall be placed to the sides of framing members to provide a continuous seal and so that the entire weight of the insulation will be carried by the framing members. Install insulation in voids around door and window frames in insulated walls. Do not compress insulation at interruptions in voids caused

by mechanical and electrical components, cut and fit insulation to completely fill voids and irregular areas. Insulation in fire rated walls shall be installed consistent with the practices and materials indicated in the pertinent UL listed design.

3.4.3 Safing Insulation

Safing insulation shall be installed at the top of fire-rated walls, at openings where cables, ducts, piping or other building components penetrate fire rated walls, or any floor deck, and as indicated on the drawings. Insulation shall be packed in openings leaving no voids. Safing insulation shall be coordinated with requirements for firestopping design requirements.

3.4.4 Sound Attenuation Insulation

Insulation installed in walls shall be securely fastened to framing members to prevent settling. Ends and edges shall be butted together and all voids shall be filled. Insulation installed over suspended ceilings shall be loose laid. Coordinate additional weight with design/installation of suspended ceiling frame.

3.4.5 Sill Sealer Insulation

Insulation shall be installed in lengths as long as practicable and in a manner that will provide a compression by the sill to a dense, uniform, continuous seal.

3.4.6 Polyisocyanurate Spray Insulation (Barracks and SCB)

Verify that all work within areas to receive insulation is complete. Remove all foreign materials that may affect the installation of the insulation. Do not spray in areas where expanding foam will displace materials that are insufficiently secured until such materials are properly secured. Comply with all of manufacturer's written application instructions for preparation and application. Mask and protect all adjacent surfaces and materials to prevent damage and overspray contamination. Apply insulation to achieve a uniform monolithic density free of voids. Fill all voids completely, including areas surrounding windows, doors, equipment and penetrations. Where the proximity of structural members or other components prohibit the introduction of insulation, apply caulking to seal all joints. Trim insulation as necessary to provide a flat surface for the installation of gypsum wallboard or other sheet products. Bowing of wallboard over insulation is not acceptable.

3.5 INSTALLATION OF VAPOR RETARDER

Vapor retarder shall be applied on the "warm" interior side of all insulation materials and as specifically indicated on drawings. Vapor retarder shall provide a continuous barrier over the entire building. Provide continuous joints, seams and sealed edges at wall perimeter, window and door frames, and all penetrations such as electrical outlets and switches, plumbing connections, and utility service penetrations per manufacturer's written instructions for installation. Joints and seams in the vapor retarder shall be lapped and sealed over supporting framing members. Provide a sealed seam between wall and ceiling applications. Sealing shall be by vapor retarder manufacturer's adhesive and/or tape materials. All penetrations to the moisture barrier, either designed or accidental, shall be repaired in a manner approved by the Contracting Officer.

END OF SECTION

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SECTION 07220

ROOF INSULATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A208.1 (1999) Particleboard Mat Formed Woods

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 208 (1995) Cellulosic Fiber Insulating Board

ASTM C 552 (2000) Cellular Glass Thermal Insulation

ASTM C 578 (1995) Rigid, Cellular Polystyrene Thermal Insulation

ASTM C 726 (2000) Mineral Fiber Roof Insulation Board

ASTM C 728 (1997) Perlite Thermal Insulation Board

ASTM C 1050 (1991) Rigid Cellular Polystyrene-Cellulosic Fiber Composite Roof Insulation

ASTM C 1177/C 1177M (1999) Glass Mat Gypsum Substrate for Use as Sheathing

ASTM C 1289 (1998) Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board

ASTM D 41 (1994) Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing

ASTM D 226 (1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing

ASTM D 312 (2000) Asphalt Used in Roofing

ASTM D 2178 (1997a) Asphalt Glass Felt Used in Roofing and Waterproofing

ASTM D 4586 (1993; R 1999) Asphalt Roof Cement, Asbestos Free

ASTM D 4897 (1998) Asphalt-Coated Glass-Fiber Venting Base Sheet
Used in Roofing

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513 (1996) Loss Prevention Data for Roofing Contractors

FM P7825a (1998) Approval Guide Fire Protection

FM P7825c (1998) Approval Guide Building Materials

UNDERWRITERS LABORATORIES (UL)

UL Bld Mat Dir (1999) Building Materials Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Application of Insulation; G

Panel layout and fastener locations for insulation consistent with insulation and roofing manufacturer's recommendations and UL test assembly for a Class 90 roof system. Identify all zones (such as at parapet, eaves and ridges) requiring additional fasteners or revised fastener spacing from the field of the roof.

SD-03 Product Data

Application of Insulation; G

Insulation manufacturer's recommendations for the application and installation of insulation.

Inspection; G

The inspection procedure for insulation installation, prior to start of roof insulation work.

SD-07 Certificates

Insulation; G
Glass Roofing Felt; G
Organic Roofing Felt; G

Certificate attesting that the insulation meets specified material requirements.
Certificates of compliance for felt materials.

1.3 STORAGE OF MATERIALS

Insulation materials shall be stored in accordance with manufacturer's instructions. Insulation, base sheet, and felt shall be kept dry at all times, before, during, and after delivery to the site and shall be stored in an enclosed building or in a closed trailer. Wet insulation, wet base sheet or wet felt shall not be used and shall be permanently removed from the site. Felts shall be stacked on end, one level high, on pallets at least 150 mm above floor surface. Felt rolls shall be maintained at a temperature above 10 degrees C for 24 hours immediately before laying.

1.4 FIRE CLASSIFICATION

Insulation shall have been tested as part of a roof construction assembly of the type used in this project, and the construction shall be listed as Fire-Classified in UL Bld Mat Dir or Class I in FM P7825a, except for installation on poured concrete decks. Total roof construction assembly shall have passed UL-790 Class A fire resistance tests.

1.5 WIND UPLIFT CLASSIFICATION

Roof assembly shall conform to UL-580 with a minimum Class-90 uplift resistance or Factory Mutual (FM) I-90 wind uplift.

1.6 THICKNESS OF INSULATION

Installed thickness of insulation shall provide an R-value of not less than R-38 (except at crickets, scuppers or low edge of areas of tapered insulation) through the completed construction air-to-air when determined for winter conditions. Minimum thickness shall be as recommended by the manufacturer. The minimum thickness of tapered insulation shall be in accordance with the insulation manufacturer's recommendations for the substrate on which the tapered insulation is to be installed and shall not allow condensation within the insulation. Insulation thickness shall be uniform over common roof areas unless specifically detailed otherwise.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of roof insulation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- 1) Observation of environmental conditions; number and skill level of insulation workers; start and end time of work.
- 2) Shop drawings include explicit identification of coordination with other trades.
- 3) Verification of certification, listing or label compliance with FM P9513.
- 4) Verification of proper storage and handling of insulation and vapor retarder materials before, during, and after installation.

- 5) Inspection of vapor retarder application, including edge envelopes and mechanical fastening.
- 6) Inspection of mechanical fasteners; type, number, length, and spacing.
- 7) Coordination with other materials, cants, sleepers, and nailing strips.
- 8) Inspection of insulation joint orientation and laps between layers, joint width and bearing of edges of insulation on deck.
- 9) Installation of cutoffs and proper joining of work on subsequent days.
- 10) Continuation of complete roofing system installation to cover insulation installed same day.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 INSULATION

Insulation shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trademark, the material specification number, the R-value at 24 degrees C, and the thickness. Boards shall be marked individually. The thermal resistance of insulation shall be not less than the R-value shown on the drawings.

The insulation manufacturing process shall not include chlorofluorocarbons (CFC) or formaldehydes. Insulation and fiberboard shall conform to EPA requirements in conformance with Section 01670 RECYCLED / RECOVERED MATERIALS. Where two materials have the same price and performance, the one having the higher recovered material content shall be selected. Insulation shall be one, or a combination of the following materials:

2.1.1 Composite Insulation Panels

Composite insulation shall be an expanded polystyrene (EPS) or extruded polystyrene (XEPS) insulation board core with 13 mm minimum thickness oriented strand board (OSB) permanently laminated to one face. As an option, 16 mm gypsum roof board may be laminated to second face. Properties of all components shall be as separately specified in this SECTION. Adhesives used to bond components shall be designed for exterior exposure. Panels shall be labeled with indication of in-plant quality control or third party inspection service in compliance with national codes. EPS cores shall extend 2 mm beyond edge of OSB to allow for expansion of OSB face. R-value of panel shall be as indicated and as tested at 4 degrees C.

2.1.2 Polyisocyanurate (Use Where Indicated on Drawings)

ASTM C 1289, Type I, or ASTM C 1289 Type II, having minimum recovered material content of 9 percent by weight of the polyisocyanurate portion of the board. All material shall be CFC (freon) free with HCFC's only as an expanding agent. Maximum thickness of each board

shall be four inches; minimum thickness shall be two inches. Where OSB is used as a nailbase or coversheet, foam shall be extended 2 mm minimum to allow for expansion of OSB. R-value used shall be aged and calculated at 5.56 per inch of thickness. All insulation shall be certified code listed. All insulation shall be aged six weeks minimum to reduce shrinkage and stabilize thermal drift.

2.1.3 Polystyrene

Polystyrene shall be in accordance with ASTM C 578, Type I, II, IV, or X when used in composite insulation panels. Polystyrene in low slope roof and tapered roof areas shall be ASTM C 578, Type IV or X. At all ballasted EPDM walkway/roof areas use ASTM C 578, Type VII only. All polystyrene shall be certified code conforming and listed as 95 percent MV (modified virgin) material. All insulation shall be aged six weeks minimum to prevent shrinkage.

2.1.4 Oriented Strand Board (OSB)

Oriented strand board shall be APA rated Exposure 1, conforming to APA PS-2 or PRP-108 performance standards. Minimum thickness shall be 13 mm. Where OSB is not part of a composite insulation panel, it shall be attached to roof deck simultaneously with the insulation material.

2.1.5 Glass Mat Gypsum Roof Board

Glass mat gypsum roof board shall be in accordance with ASTM C 1177/C 1177M, flame spread - 0, smoke developed - 0, 3446 kPa (500 psi) Class A non-combustible. Minimum thickness shall be 16 mm.

2.2 NAILS AND FASTENERS

Fasteners shall be specifically designed screws and plates (disks) of sufficient length to hold insulation securely in place. Fasteners and discs shall conform to FM P7825c, be rated for Class I fire and I-90 wind uplift and spaced to withstand an uplift pressure of 4.3kPa (90 pounds per square foot). Fasteners shall conform to insulation manufacturer's recommendations except that holding power, when driven, shall be not less than 534 N (120 pounds) each in steel deck.

2.2.1 Fasteners

Fasteners to secure insulation to steel decking shall be self-drilling heavy-duty screws. Fasteners shall have a fluropolymer or similar corrosion resistant coating and significant surfaces of fasteners such as heads, shoulders and shanks (not threads) shall show no sign of red rust after 800 hours of exposure in 5 percent salt spray in accordance with ASTM B 117.

2.2.2 Discs

Discs for distributing wind uplift loads from insulation to fasteners shall be either plastic or metal and shall be designed to prevent high frequency vibration backout of fasteners. Metal discs shall be coated for corrosion resistance. Plates shall be "locking" type that secures the

fastener head down to the plate. Plates shall feature positive locking to the insulation by means of teeth at the bottom of the plate to resist rotation.

2.2.3 Nails

Nails shall be hot-dip galvanized of the type and style best suited for the intended purpose.

2.3 GLASS ROOFING FELT

ASTM D 2178, Type IV.

2.4 ORGANIC ROOFING FELT

ASTM D 226, Type I.

2.5 WOOD NAILERS

Wood nailers shall conform to SECTION: ROUGH CARPENTRY, including preservative treatment. Edge nailers shall be not less than nominal 150 mm wide and of thickness to finish flush with the top surface of the insulation. Surface mounted nailers shall be a nominal 75-mm wide by the full thickness of the insulation. Preservative treated wood in contact with insulation, steel decking or roofing membranes shall be fully compatible and non-corrosive with those materials.

2.6 VAPOR RETARDER

Vapor retarder shall be 8-mil thick reinforced polyethylene sheeting or polyethylene sheet between plies of reinforced kraft paper. Vapor retarder shall have a vapor-permeance rating of less than 0.5 perm when tested by the water method in accordance with ASTM E 96. Flame spread rating shall not exceed 25 when tested in accordance with ASTM E 84 and shall be resistant to puncture, abrasion and tearing. Adhesive for sealing laps of vapor barrier shall be manufacturer's recommended product.

PART 3 EXECUTION

3.1 COORDINATION REQUIREMENTS

Insulation and roofing membrane shall be finished in one operation up to the line of termination at the end of each day's work. Completed sections shall be waterproofed when more than one day is required to finish the roofing. Phased construction will not be permitted.

3.2 ENVIRONMENTAL CONDITIONS

The temperature of the roofing materials shall be as required by the manufacturer. Air temperature shall be above 4 Degrees C and there shall be no visible ice, frost, or moisture on the roof deck when the insulation and roofing are installed. Wind conditions shall be suitable for installation of insulation: Wind chill may affect the proper application temperatures of materials; hot materials may be blown about, creating safety dangers; insulation boards may become difficult and hazardous to handle; wrappers, coverings, and other debris may become airborne, and possibly contaminate laps and seams.

3.3 SUBSTRATE PREPARATION

The substrate construction of any bay or section of the building shall be completed before insulation or vapor retarder work is begun thereon. Vents and other items penetrating the roof shall be secured in position and properly prepared for flashing. All roof penetrations shall be routed through simulated chimneys. Roof curbs, parapets, crickets and similar constructions shall be secured in position and prepared for flashing. Prior to application of vapor retarder or insulation, substrate joints shall be covered with a 100-mm strip of roofing felt, embedded in and coated with asphalt cement. Substrate surface shall be smooth, clean, and dry at time of application.

3.4 VAPOR RETARDER

Vapor retarder shall be installed at all locations where insulation is present above the structural roof deck. Do not install vapor retarder at Barracks roof areas. Vapor retarder shall be installed to provide a continuous membrane. All joints shall be lapped a minimum of 80 mm. All lapped joints shall be sealed with adhesive. Rips, tears and other damaged areas shall be recovered and sealed, lapping underlying membrane by at least 80 mm. All penetrations through vapor retarder shall be sealed vapor tight.

3.5 INSTALLATION OF WOOD NAILERS

Nailers shall be secured to steel decks as indicated. Bolt anchors shall have nuts and washers countersunk, and bolts shall be cut flush with top of nailer. Powder-actuated fasteners, sized and spaced for nailer anchorage equivalent to that specified and indicated, may be used when approved. Surface mounted nailers shall be installed parallel with the roof slope and shall be spaced not over 1.2 meters face-to-face, except that where the insulation units are less than 1.2 meters in length the nailers shall be spaced to minimize cutting of the insulation.

3.6 APPLICATION OF INSULATION

Insulation (including foam insulation, gypsum roof board and OSB) shall be tightly butted and secured to the substrate. Insulation around scuppers shall be tapered as necessary to provide a smooth transition between roof surface and scupper. Roof perimeter and edge of roof penetrations shall have preservative treated wood nailers as detailed. Where insulation is not installed as a composite panel it shall be laid in two or more layers. Units of insulation shall be laid in courses parallel with the roof slope. End joints shall be staggered. Insulation shall be cut to fit neatly against adjoining surfaces. Joints between insulation boards shall not exceed 6 mm. Joints in successive layers shall be staggered with respect to joints of preceding layer. Where insulation is applied over steel deck, long edge joints shall continuously bear on surfaces of the steel deck. Insulation that can be readily lifted after installation is not considered to be adequately secured. Insulation shall be applied so that all roof insulation applied each day is waterproofed the same day. Phased construction will not be permitted. Application of impermeable faced insulation shall be performed without damage to the facing.

3.6.1 Mechanical Fastening

On steel decks, for any slope exceeding 42 mm/m, all layers of insulation shall be mechanically fastened. Method of attachment shall be in accordance with recommendations

of the insulation manufacturer and requirements specified. Insulation shall be attached with mechanical fasteners and discs installed consistent with UL 580 Class 90.

3.6.2 Steel Decks

All steel decks shall be insulated before receiving a roof membrane. First layer of insulation on steel deck shall be compatible with mechanical fastening and shall meet code requirements for Thermal Index of 15.

3.6.3 Foam Insulation

Polystyrene shall not be exposed to solvent-base adhesive, coal-tar bitumen or to asphalt which is hotter than 93 degrees C.

3.6.4 Glass Mat Gypsum Roof Board

Gypsum roof board shall be installed between metal deck and foam insulation at all insulated roof areas. Gypsum roof board may be installed as an independent layer or as the bottom face of a composite insulation panel. Installation as a separate layer shall be consistent with all assembly requirements necessary to meet fire and wind uplift classifications.

3.6.5 Protection Requirements

The insulation shall be kept dry at all times. Insulation boards shall not be kicked into position. Exposed edges of the insulation shall be protected by cutoffs at the end of each work day or whenever precipitation is imminent. Cutoffs shall be 2 layers of bituminous-saturated felt set in plastic bituminous cement. Cutoffs shall be removed when work is resumed. Edges of insulation at open spaces between insulation and parapets or other walls and spaces at curbs, scuttles, and expansion joints, shall be protected until permanent roofing and flashing is applied. Storing, walking, wheeling, or trucking directly on insulation or on roofed surfaces will not be permitted. Smooth, clean board or plank walkways, runways, and platforms shall be used, as necessary to distribute weight to conform to manufacturer's indicated live load limits of roof construction.

END OF SECTION

SECTION 07240

EXTERIOR INSULATION AND FINISH SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 67	(2000) Sampling and Testing Brick and Structural Clay Tile
ASTM C 150	(1999a) Portland Cement
ASTM C 473	(2000) Physical Testing of Gypsum Panel Products
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 847	(1995) Metal Lath
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1177/C 1177M	(1999) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1186	(1999e1) Flat Non-Asbestos Fiber Cement Sheets
ASTM D 968	(1993) Abrasion Resistance of Organic Coatings by Falling Abrasive
ASTM D 2247	(1999) Testing Water Resistance of Coatings in 100% Relative Humidity
ASTM D 3273	(1994) Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 136	(1999) Behavior of Materials in a Vertical Tube Furnace at 750 Degrees C

ASTM E 330	(1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 695	(1979; R 1997e1) Measuring Relative Resistance of Wall, Floor, and Roof Construction to Impact Loading
ASTM E 2098	(2000) Determining Tensile Breaking Strength of Glass Fiber Reinforcing Mesh for Use in Class PB Exterior Insulation and Finish Systems (EIFS), after Exposure to a Sodium Hydroxide Solution
ASTM G 23	(1996) Operating Light- Exposure Apparatus(Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials

EIFS INDUSTRY MEMBERS ASSOCIATION (EIMA)

EIMA TM 101.01	(1995) Freeze/Thaw Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB
EIMA TM 101.86	(1995; Rev Aug 1995)Resistance of Exterior Insulation and Finish Systems (EIFS), Class PB to the Effects of Rapid Deformation (Impact)

INTERNATIONAL CONFERENCE OF BUILDING OFFICIALS (ICBO)

ICBO Bldg Code	(1997) Uniform Building Code (3 Vol.)
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INTERNATIONAL CODE COUNCIL ICC)

ICC Bldg Code	(2000) International Building Code
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 268	(1996)Determining ignitability of Exterior Wall Assemblies Using a Radiant Heat Energy Source
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with ECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Drawings showing wall layout, construction and expansion joints, decorative grooves, layout of sheathing board, thermal insulation board, and reinforcing fabric mesh and strip reinforcing fabric mesh; joint and flashing details; types and location of fasteners; details at windows, louvers and miscellaneous wall penetrations; details at base, roof, parapet, corners, and edges with brick and precast concrete materials; and isometric drawings showing intersection of flashings, window frames, and EIFS at corners, etc.

SD-03 Product Data

Exterior Insulation and Finish System; G

System manufacturer's literature including specifications and details. Joint and other details, such as end conditions, corners, windows, and parapet, shall be included. For sealants, shelf life and recommended cleaning solvents shall be included. Material safety data sheets (MSDS) shall be supplied for the components of the EIFS and be available at the job site.

Two copies of manufacturer's standard printed instructions for installation of the EIFS. Instructions shall include manufacturer's recommended details for corner treatment, jambs, sills, openings, joints and other special applications.

Water Vapor Transmission Analysis; G

The temperature and relative humidity for the inside and outside of the building. A complete listing of building components, including the thicknesses, thermal resistances and vapor data for each layer of the wall system, as well as building location and use shall be attached.

SD-04 Samples

Exterior Insulation and Finish System; G

Two samples of each exterior insulation and finish system demonstrating aesthetic effects, color and qualities of materials and execution. Sample size approximately 300 mm x 300 mm.

SD-06 Test Reports

Exterior Insulation and Finish System; G

Test Reports by an approved, independent testing laboratory indicating that the EIFS complies with the specified performance requirements.

SD-07 Certificates

Qualifications; G

Evidence that the manufacturer has a minimum of 3 years experience manufacturing EIFS. A list of installations using the same products and applicator shall be included.

Certification from sealant manufacturer attesting that the sealant applicator is approved for the proper sealant installation for EIFS.

Third Party Inspection; G

Certification from Third Party inspector of current Exterior Design Institute, or equal inspector certificate, attesting that the inspector is trained in proper installation of EIFS.

Installer; G

Certification attesting that EIFS installer is trained and approved by the EIFS manufacturer.

Warranty; G

At the completion of the project, signed copies of the 5-year warranty for the EIFS, a sample copy of which is attached to this section, and the manufacturer's standard material warranties.

Quality Control; G

Filled-out inspection checklist, certifying that the installation of critical items meets the requirements of this specification.

SD-10 Operation and Maintenance Data

Exterior Insulation and Finish System; G

Manufacturer instructions for repair and maintenance procedures.

1.3 DESCRIPTION

The exterior insulation and finish system (EIFS) shall be a job-fabricated exterior wall covering consisting of insulation board, reinforcing fabric mesh, base coat, finish coat, and accessories. The system components shall be compatible with each other and with the substrate and be products of, or approved by, a single manufacturer regularly engaged in furnishing exterior insulation and finish systems. Only an installer trained and approved by the EIFS manufacturer shall be used. EIFS shall be Class PB with provision for internal water drainage. Finished surface shall have a "sand" texture finish, color as indicated on the drawings.

1.4 PERFORMANCE REQUIREMENTS

Unless otherwise noted, the test specimens shall consist of reinforcement, base coat and finish coat applied in accordance with the manufacturer's printed recommendations to an insulation board common to the system. These specimens shall be suitably sized for the apparatus used and allowed to cure for a minimum of 28 days prior to testing.

1.4.1 Abrasion Resistance

The system shall be tested for abrasion resistance in accordance with ASTM D 968, Method A. A minimum of two specimens shall be tested with no cracking, checking, or loss of film integrity after 500 liters of sand.

1.4.2 Accelerated Weathering

The system shall be tested for accelerated weathering in accordance with ASTM G 23, Method 1. The specimen shall be tested for a period of 2,000 hours without visible cracking, flaking, peeling, blistering, yellowing, fading, or other such deteriorations.

1.4.3 Mildew-Fungus Resistance

The system shall be tested for mildew-fungus resistance using ASTM D 3273. The specimen shall consist of the finish coat material only, applied to clean 75 by 100 mm glass slides and shall be allowed to cure for 28 days. After 28 days of exposure the specimens shall not show any growth.

1.4.4 Salt Spray Resistance

The system shall be tested for salt spray resistance in accordance with ASTM B 117. The specimens shall be a minimum size of 100 by 150 mm and shall be tested for 300 hours with no observable deterioration.

1.4.5 Water Penetration

The system shall be tested for water penetration by uniform static air pressure in accordance with ASTM E 331. No penetration of water beyond the plane of the base coat/EPS board interface after 15 minutes at 299 Pa, (6.24 psf) or 20% of positive design wind pressure, whichever is greater.

1.4.6 Water Resistance

The system shall be tested for water resistance in accordance to ASTM D 2247. The specimens shall be a minimum size of 100 by 150 mm and shall be tested for 14 days with no cracking, checking, crazing erosion, blistering, peeling or delamination after 14 days exposure.

1.4.7 Freeze/Thaw Resistance

Class PB specimens shall be tested for 60 cycles with no cracking, checking, or splitting and have negligible weight gain in accordance with EIMA TM 101.01 test method.

1.4.8 Fire Resistance

1.4.8.1 Surface Burning Characteristics

Flame spread test samples shall consist of base coat, reinforcing fabric mesh and finish coat, applied to a non-combustible substrate. A minimum of three samples shall be tested in accordance with ASTM E 84 and shall have a flame spread index of 25 or less and a smoke development value of 450 or less.

1.4.8.2 Flammability Characteristics (Full-Scale or Intermediate-Scale Multistory Fire Test)

Multistory wall fire test specimens shall include the complete system with no less than 100 mm of insulation board. Test shall be performed in accordance with UBC Standard 26-4 or (optional) UBC Standard 26-9 both contained in Volume 3 of ICBO Bldg. Code, and must meet the conditions of acceptance which include:

- a. No vertical spread of flame within the core of the panel from one story to the next.
- b. No flame propagation over the exterior surface.
- c. No vertical spread of flame over the interior surface from one story to the next.
- d. No significant lateral spread of flame from the compartment of fire origin to adjacent spaces.

1.4.8.3 Radiant Heat

The system shall be tested in accordance with NFPA 268 with no ignition during the 20 minute period.

1.4.8.4 Fire Endurance

The system shall be tested according to ASTM E 119 with no effect on the fire resistance rating of the wall assembly.

1.4.9 Impact Resistance

1.4.9.1 Hemispherical Head Test

The Class PB system shall have been tested and shown to be capable of withstanding an impact of 3-6 N-m when tested in accordance with EIMA TM 101.86.

1.4.9.2 Impact Mass

The Class PM system shall have been tested in accordance with ASTM E 695. No cracking or denting after twelve impacts by 13.6 kg lead shot mass from 150 to 1800 mm drop heights in 150 mm intervals.

1.4.10 Wind Load

Test panels shall consist of steel stud framing, screw attached exterior sheathing board, minimum 20 mm thick insulation board, and the finish system. The system shall have been tested in accordance with ASTM E 330 (Procedure A) to minimum positive pressures of 1.23 kPa and negative pressures of 1.23 kPa. No permanent deformation, delamination, or other deterioration at 1.5 times the design wind load, both positive and negative.

1.5 WATER VAPOR TRANSMISSION ANALYSIS

Perform a water vapor transmission analysis based on the project specific climate.

1.6 QUALITY ASSURANCE

1.6.1 Qualifications

- a. The EIFS shall be the product of a manufacturer who has been in the practice of manufacturing and designing EIFS for a period of not less than 3 years, and has been involved in at least five projects similar to this project in size, scope and complexity.
- b. The Contractor shall be trained and approved by the EIFS manufacturer to install the system and shall have successfully installed at least five projects at or near the size and complexity of this project. The Contractor shall employ qualified workers trained and experienced in installing the manufacturer's EIFS.
- c. Sealant applicator shall be experienced and competent in the installation of high performance industrial and commercial sealants and shall have successfully installed at least five projects at or near the size and complexity of this project.
- d. Insulation board shall be approved and labeled under a third party quality program as required by applicable building code.

1.6.2 Field Sample Installations

Before installing system, sample installations shall be constructed for each form of construction and finish required to verify selections made under Sample submittals and to demonstrate aesthetic effects and qualities of materials and execution. Sample installations shall be built as part of the brick veneer sample panel specified in SECTION: NON-BEARING MASONRY VENEER/STEEL STUD WALLS. Sample shall include vertical transition from EIFS to brick construction and joints at window perimeter. Sample shall comply with the following requirements, using materials indicated for completed work:

- a. Locate sample installations in the location and of the size indicated.
- b. Demonstrate the proposed range of color, texture, thickness, installation and workmanship. Include typical joints and sealant.
- c. Obtain Contracting Officer's written approval of sample installations before starting fabrication of work.

- d. Maintain sample installations during construction as a standard for judging the completed work, protecting them from weather and construction activities.
- e. When directed, demolish and remove sample installations from the site.

1.6.3 Pre-Installation Conference

After approval of submittal and before commencing any work on the EIFS, the Contracting Officer will hold a pre-installation conference to review:

- a. Drawings and specifications;
- b. Procedure for onsite inspection and acceptance of EIFS substrate and pertinent details;
- c. Contractor's plan for coordination of work of the various trades involved in providing the EIFS and other components;
- d. Inspection procedures;
- e. Safety requirements.

Pre-installation conference shall be attended by the Contractor, EIFS Q.C. Specialist (EIFS Inspector), and all personnel directly responsible for installation of the EIFS, including sealant applicator, and personnel responsible for related work, such as brick veneer, precast concrete, flashing and sheet metal, windows and doors, and a representative of the EIFS manufacturer. Before beginning EIFS work, the Contractor shall confirm in writing the resolution of conflicts among those attending the pre-installation conference.

1.7 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in their original unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents. Storage shall be in accordance with the manufacturer's recommendations in a clean, dry, well-ventilated area. Stored materials shall be protected from sunlight, and kept away from excessive heat. Coating materials, which would be damaged by freezing, shall be kept at a temperature not less than 4 degrees C. Insulation board shall not be exposed to flame or other ignition sources.

1.8 ENVIRONMENTAL CONDITIONS

Unless a higher temperature is required by the system manufacturer, the ambient air temperature shall be 4 degrees C or greater and rising at the time of installation. Supplemental heat may be used to maintain this ambient temperature. The system shall be protected from exposure to temperatures below 4 degrees C for at least 24 hours after installation. EIFS shall not be applied during inclement weather unless appropriate protection is provided. Installed materials shall be protected from inclement weather until they are dry.

1.9 WARRANTY

Manufacturer's standard warranty for the EIFS shall be furnished. Warranty shall run directly to the Government and cover a period of not less than 5 years from date of Government's acceptance.

PART 2 PRODUCTS

2.1 SHEATHING BOARD

2.1.1 Cement Board

Sheathing, minimum 13 mm thick, shall be non-combustible exterior cement board per ASTM E 136. Sheathing boards shall meet the requirements of ASTM C 1186, Type B, Grade I, water absorption not to exceed 17 percent maximum. Nail Pull Resistance, when tested in accordance with ASTM C 473, shall be no less than 534 N.

2.2 ADHESIVE

Adhesive shall be the manufacturer's standard product, including primer as required, and shall be compatible with the substrate, insulation board and reinforcing mesh to which the system is applied. Mechanical anchors shall supplement or replace adhesive based on wind loads, thickness or layering of insulation and/or manufacturer's written recommendations.

2.3 INSULATION BOARD

2.3.1 General Requirements

Insulation board shall conform to ASTM C 578, type as recommended by the system manufacturer and shall be compatible with other system components. Insulation board shall be certified as aged, in block form prior to cutting and shipping, a minimum of 6 weeks by air drying, or equivalent. Insulation board shall be a standard product of the manufacturer and shall be factory marked with the manufacturer's name or trade mark, the material specification number, the R-value at 24 degrees C, and the thickness. Thickness of insulation board shall be based on specified R-value, but no single layer shall be less than 20 mm thick. The maximum thickness of all layers of insulation board combined shall not exceed 100 mm. Boards shall be marked individually. The thermal resistance of insulation board in the system shall be not less than the R-value shown on the drawings. Board immediately adjacent to sheathing shall have vertical grooves to provide drainage channels.

2.3.2 Recycled Materials

As available, insulation board shall conform to EPA requirements in accordance with SECTION: RECYCLED / RECOVERED MATERIALS.

2.4 BASE COAT

Base coat shall be the manufacturer's standard product and shall be compatible with other system components.

2.5 PORTLAND CEMENT

Portland cement shall conform to ASTM C 150, Type I or II as required, shall be fresh, free of lumps, and approved by the system manufacturer.

2.6 REINFORCING FABRIC MESH

Reinforcing fabric mesh shall be alkali-resistant, balanced, open weave, glass fiber fabric made from twisted multi-end strands specifically treated for compatibility with the other system materials, and comply with ASTM E 2098.

2.6.1 Medium Weight Reinforcing Mesh

Weight shall be at least 12 oz/sy.

2.6.2 Heavy Weight Reinforcing Mesh

Weight shall be at least 20 oz/sy. Embed heavy weight reinforcing mesh in base course consistent with manufacturer's written recommendations. Use heavy weight reinforcing mesh at all wall surfaces within 3 meters of grade, two meters of roof eaves, full height of parapets and within reach of any accessible surface (such as stairs, decks and roofs) located above grade.

2.7 MECHANICAL FASTENERS

Mechanical fasteners shall be corrosion resistant and as recommended by the system manufacturer. Select fastener type and pattern based on applicable wind loads and substrate into which the fastener will be attached, to provide the necessary pull-out, tensile and shear strengths.

2.8 FINISH COAT

The finish coat shall be manufacturer's standard product of the color and texture specified. For color consistency, use materials from the same batch or lot number.

2.9 JOINT SEALANT

Joint sealant shall meet requirements of ASTM C 920, Class 25, and shall be compatible with the EIFS materials. Type, Grade, and Use shall be as recommended by both the sealant manufacturer and the system manufacturer. When required, primer, bond breaker and backer rod shall be non-staining, and as recommended by the sealant manufacturer and the system manufacturer. Only closed-cell, non-adsorptive materials shall be used as backer rod. The backer rod shall be sized 25 to 30 percent larger than the width of the joint.

2.10 WEATHER RESISTANT BARRIER

Weather resistant barrier shall be a tear and puncture resistant olefin building wrap (polyethylene or polypropylene) with a moisture vapor transmission rate of 125 grams per square meter per 24 hours in accordance with ASTM E 96, Desiccant Method at 63 degrees C, or with a moisture vapor transmission rate of 670 grams per square meter per 24 hours in accordance with ASTM E 96, Water Method at 23 degrees C.

2.11 ACCESSORIES

Accessories shall conform to the recommendations of the system manufacturer and shall include items such as trim, edging, exterior tape and other specialty components required for proper installation of the system. All metal items shall be corrosion resistant.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Surface shall be sound and free of oil, loose materials or protrusions which will interfere with the system installation. For adhesively attached EIFS, existing deteriorated or weathered paint must be removed. Due to substrate conditions or as recommended by the system manufacturer, a primer may be required. The primer shall be mixed and applied per the manufacturer's instructions. The substrate shall be plane, with no deviation greater than 6 mm when tested with a 3 m straightedge. The Contractor shall not proceed with the installation until all noted deficiencies are corrected.

3.2 INSTALLATION

Installation shall conform to the system manufacturer's printed recommendations except as otherwise specified. Acceptable installer shall be prequalified under the requirements of paragraph QUALITY ASSURANCE.

3.3 WEATHER RESISTANT BARRIER

Install weather resistant barrier on exterior face of studs with tape or adhesive as recommended by system manufacturer. Immediately install sheathing board over weather resistant barrier. Edges of barrier shall be returned into all openings. Overlap adjacent sheets at least 150 mm. Provide water resistant reinforcing tape at all edges and corners of openings.

3.4 SHEATHING BOARD

Sheathing board shall be attached to studs with self-tapping, corrosion resistant screws, or secured to concrete or masonry with approved fasteners. Screws for application of the sheathing board shall be spaced not more than 200 mm on each supporting member, and fasteners into concrete or masonry shall be spaced not more than 300 mm apart horizontally and vertically. Fasteners shall be more closely spaced when required for negative wind load resistance. Edges and ends of sheathing boards shall be butted snugly with vertical joints staggered to provide full and even support for the insulation board. Drive all fasteners flush with surface. Do not overdrive.

3.5 INSULATION BOARD

Insulation board shall be applied using adhesive spread with a notched trowel to the back of the insulation boards in accordance with the manufacturer's instructions. Initial course shall be supported in manufacturer's standard draining track. Align drainage holes so that any water drains into cavity behind brick veneer. If used, mechanical fasteners shall be installed and spaced in accordance with the manufacturer's written instructions. Unless otherwise

specified by the system manufacturer, insulation boards shall be placed with the long edge horizontal from a level base line. Vertical joints shall be staggered and insulation boards interlocked at corners. L-shaped insulation board pieces shall be used at corners of openings. Joints between boards shall not align with window, door or louver openings or miscellaneous wall penetrations. Joints of insulation boards shall be butted tightly. Surfaces of adjacent insulation boards shall be flush at joints. Gaps greater than 2 mm between the insulation boards shall be filled with slivers of insulation board. Joints of insulation board shall be offset from substrate joints by at least 200 mm. Uneven board surfaces with irregularities projecting more than 2 mm shall be rasped in accordance with the manufacturer's instructions to produce an even surface. The adhered insulation board shall be allowed to remain undisturbed for 24 hours prior to proceeding with the installation of the base coat/reinforcing mesh, or longer if necessary for the adhesive to dry.

3.6 BASE COAT AND REINFORCING FABRIC MESH

3.6.1 Class PB EIFS

Base coat shall be mixed in accordance with the manufacturer's instructions and applied to insulated wall surfaces to the thickness as specified by the system manufacturer. The reinforcing fabric mesh shall be trowelled and fully embedded into the wet base coat material. When properly worked-in, the pattern of the reinforcing fabric mesh shall not be visible. Diagonal reinforcement shall be provided at opening corners. All terminations of the EIFS shall be backwrapped. The reinforcing fabric mesh shall be overlapped a minimum of 65 mm on previously installed mesh, or butted, in accordance with the manufacturer's instructions. Use medium weight mesh on entire field of EIFS, substituting heavy weight product at locations indicated. The adhered insulation board shall be allowed to dry for 24 hours, or longer if necessary, prior to proceeding with the installation of the base coat/reinforcing fabric mesh.

3.7 EXTERIOR PRIMER

Apply manufacturer's standard primer according to written instructions. Allow primer to dry thoroughly before commencing application of finish coat. Follow all weather restrictions during application and drying/curing period.

3.8 FINISH COAT

Inspect surface for defects and complete repairs prior to application of finish coat. Surface irregularities such as trowel marks, board lines, reinforcing mesh laps, etc., shall be corrected prior to application of the finish coat. Finish coat shall be applied and leveled in one operation. Final texture shall be obtained by trowels, floats, or by spray application as necessary to achieve the required finish. The finish coat shall be applied to the dry base coat in a continuous operation without cold joints, maintaining a wet edge at all times to obtain a uniform appearance. The thickness of the finish coat shall be in accordance with the system manufacturer's current published instructions. Finish coat shall be applied without covering surfaces to which joint sealants are to be applied. The base coat/reinforcing mesh shall be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat. Finish surfaces shall be plane, with no deviation greater than 6 mm when tested with a 3 meter straight edge.

3.9 JOINT SEALANT

EIFS shall be sealed at openings as recommended by the system manufacturer.

3.9.1 Surface Preparation, Backer Rod, and Primer

The following steps shall be performed: a.) Immediately prior to application, remove loose matter from joint. b.) Ensure that joint is dry and free of paint, finish coat, or other foreign matter. c.) Install backer rod. d.) Apply primer as required by sealant and EIFS manufacturer. e.) Check that joint width is as shown on drawings, but in no case less than 13 mm for perimeter seals and 20 mm for expansion joints (the width shall not be less than 4 times the anticipated movement). f.) Check sealant manufacturer's recommendations regarding proper width to depth ratio.

3.9.2 Sealant

The following requirements shall be adhered to: a.) Apply sealant in accordance with sealant manufacturer's instructions with gun having nozzle that fits joint width. b.) Do not use sealant that has exceeded shelf life or cannot be discharged in a continuous flow. c.) Completely fill the joint solidly with sealant without air pockets so that full contact is made with both sides of the joint. d.) Tool sealant with a round instrument that provides a concave profile and a uniformly smooth and wrinkle free sealant surface. e.) Do not wet tool the joint with soap, water, or any other liquid tooling aid. f.) Do not apply sealant until all EIFS coatings are fully dry. g.) During inclement weather, protect the joints until sealant application. h.) Use particular caution in sealing joints between window and door frames and the EIFS wall and at all other wall penetrations. i.) Clean all surfaces to remove excess sealant.

3.10 CLEAN-UP

Upon completion of the work, all scaffolding, equipment, materials and debris shall be removed from site. All temporary protection installed to facilitate installation of EIFS shall be removed.

3.11 INSPECTION

3.11.1 Third Party Inspection

All inspections shall be made by an Exterior Design Institute (EDI) certified inspector, or equivalent independent party, trained in the proper installation of EIFS.

3.11.2 Quality Control

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed EIFS with contract requirements. Work found to be not in compliance shall be removed and replaced or corrected in an approved manner. Inspection shall include, but not be limited to the following:

CHECKLIST

Item Description
Approve

a. Materials are handled and stored correctly.

b. Environmental conditions are within specified limits, including temperature not below 4 degrees C, and the work is protected from the elements as required.

c. Preparation and installation is performed by qualified personnel using the correct tools.

d. Adjacent surfaces, including windows and doors, to which the system is not to be applied shall be protected from accidental application of EIFS materials through the use of masking tapes, plastic films, drop cloths, etc.

e. Control, expansion and aesthetic joints are installed as indicated or recommended. Accessories are properly installed.

f. Substrate is in-plane, properly attached, clean, dry, and free of contaminants. Concrete substrate is free of efflorescence.

g. Materials are mixed thoroughly and in proper proportions.

h. Adhesive is applied in sufficient quantity with proper-size notched trowel for the manufacturer recommended pattern.

i. Mechanical attachments are of the proper type, spacing, layout and fastener depth.

j. Insulation boards are tightly abutted, in running bond pattern, with joints staggered with the sheathing, board corners interlocked, L-shaped boards around openings, edges free of adhesive, and provision for joints. Gaps are filled and surfaces rasped.

- k. Insulation board adhesive must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.
-

- l. Reinforcing fabric mesh is properly backwrapped at terminations.
-

- m. Reinforcing fabric mesh is fully embedded and properly placed. Corners are reinforced. Openings are diagonally reinforced. Mesh overlaps minimum 65 mm.
-

- n. Base coat thickness is within specified limits.
-

- o. The base coat/reinforcing fabric mesh must be allowed to dry (a minimum of 24-hours) prior to the application of the finish coat.
-

- p. Finish coat is applied with sufficient number of personnel and stopped at suitable points. Floats and methods of texturing are uniform.
-

- q. Flashings and joint sealant are properly installed and applied at time specified by the manufacturer.
-

- r. All scaffolding, equipment, materials, debris and temporary protection are removed from the site upon completion.
-

END OF SECTION

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SECTION 07322

CONCRETE TILE ROOFING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 370	(1992) Copper Sheet and Strip for Building Construction
ASTM C 387	(2000) Packaged, Dry, Combined Materials for Mortar and concrete.
ASTM C 887	(1996) Packaged, Dry, Combined Materials for Surface Bonding Mortar
ASTM C 920	(2001) Elastomeric Joint Sealants
ASTM C 1184	(1995) Structural Silicone Sealants
ASTM C 1492	(2001) Concrete Roof Tile
ASTM D 146	(1997) Sampling and Testing Bitumen-Saturated Felts and Woven Fabrics Used in Roofing and Waterproofing
ASTM D 226	(1997) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 412	(1998a) Vulcanized Rubber and Thermoplastic Rubbers and Thermoplastic Elastomers - Tension
ASTM D 2822	(1991; R 1997) Asphalt Roof Cement

INTERNATIONAL BUILDING CODE (IBC)

IBC 2000	(2000) International Code Council
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NATIONAL ROOFING CONTRACTORS ASSOCIATION (NRCA)

NRCA R&W Manual	(1996; Addenda Dec 1996; May 1998) NRCA Roofing and Waterproofing Manual
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL
ASSOCIATION (SMACNA)

SMACNA Arch. Manual (1993; Errata; Addenda Oct 1997) Architectural Sheet
Metal Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Concrete Tile Roofing Systems; G

Drawings showing concrete tile installation and appearance details, flashing details, and fastening details for the tiles.

SD-03 Product Data

Concrete Tile Roofing Systems; G

Manufacturer's catalog data and installation instructions.

Qualifications; G

Documentation showing qualifications of personnel proposed to perform the roofing work, and a listing identifying prior installations completed by the Contractor.

SD-04 Samples

Concrete Roofing Tile; G

One representative tile of each type.

Sealants;

237 ml (8 ounces) of each type.

Underlayment Membrane;

300 by 300 mm (1 by 1 foot) section of each type.

Fasteners; G

Representative samples of each fastener with identifying tags.

SD-07 Certificates

Materials; G

Certificates of compliance attesting that the materials meet specification requirements.

1.3 QUALIFICATIONS

The Contractor shall provide qualified workers, trained and experienced in installing concrete tile roofing systems of this configuration, and shall submit documentation of 5 consecutive years of work of this type. The Contractor shall be familiar with and shall perform work in accordance with SMACNA Arch. Manual for flashing installation and NRCA R&W Manual. A list of installations shall be provided which identifies when, where, and for whom the installations were made.

1.4 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in manufacturer's unopened bundles and containers with the manufacturer's brand and name marked clearly thereon. Tiles shall be stored in accordance with manufacturer's printed instructions. Roll goods shall be stored on end in an upright position. Immediately before laying, roofing felt shall be stored for 24 hours in an area maintained at a temperature not lower than 10 degrees C. (50 degrees F.)

1.5 PROJECT/SITE CONDITIONS

1.5.1 Environmental Requirements

Concrete tile roofing work shall proceed when existing and forecasted weather conditions permit work to be performed in accordance with manufacturer's recommendations and warranty requirements.

1.5.2 Material Storage

Materials shall not be stored on roof decks in such a manner as to overstress and/or damage the deck and supporting structure. Placing of loads at midspans of framing shall be avoided. Superimposed loads shall be well distributed.

1.5.3 Units of Work

Units of work shall be established, including removal of existing materials, preparation of existing surfaces and application of underlayment and nailers, and related temporary and/or permanent flashing so that it can be completed prior to the end of each working day.

1.5.4 Temporary Protection Materials

Materials shall be provided and maintained on the site at all times for temporary roofing, flashing, and other protection when delays and/or changed weather conditions do not permit completion of each unit of work prior to the end of each working day. Materials that have been used for temporary roofing, flashing and other protection shall be removed and discarded.

1.6 WARRANTY

A warranty shall be furnished against defects in material and workmanship of concrete tile roof assembly, including related metal flashing for a period of 5 years from date of final acceptance of the work. Furnish a separate manufacturer's written 50-year warranty on the concrete tile.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of the installed roof with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of the substrate.
- (2) Verification of compliance of materials before, during and after installation.
- (3) Inspection of condition of equipment.
- (4) Inspection of flashings, cants, nailers, expansion joints, parapet walls and roof penetrations.
- (5) Inspection of fastening of plywood sheathing to metal deck, fastening of batten strips to sheathing and fastening of tiles.

A roofing technician responsible directly to the Contractor and experienced in the construction of concrete tile roof systems and related work shall perform the quality control functions and be on each site whenever roofing operations are in progress.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Concrete Roofing Tile

Concrete roofing tile shall conform to ASTM C 1492 and ICBO Standard Number 4907. Tile shall be interlocking flat slate type. Tile shall be unglazed.

2.1.1.1 Colors

Concrete tile color shall be as indicated on the drawings.

2.1.1.2 Fittings and Trim

Concrete tile fittings shall be of the following types as required by manufacturer's instructions: eave - eave closure; gable - gable rake; ridge - ridge closed ridge end; valley - open valley. All fittings and trim shall match the color, style and surface texture of field tile.

2.1.2 Underlayment Membrane

An underlayment membrane shall be furnished on surfaces to be covered with tile or metal flashing. Membrane shall consist of asphalt-saturated felt and high strength composite self-adhering membrane

2.1.2.1 Roofing Felt

Roofing felt shall be asphalt-saturated rag felt, Type II, No. 30 asphalt felt in accordance with ASTM D 226.

2.1.2.2 Self-adhering Membrane

Membrane shall be a cold applied composite self-adhering membrane, minimum 1.0 mm (0.040 inch) thick, high strength polyethylene film with slip resistant embossing, coated on one side with a thick layer of adhesive-consistency rubberized asphalt, interwound with a disposable silicone coated release sheet. The tensile strength and elongation values shall be not less than 1720 kPa (250 psi) when tested in accordance with ASTM D 412 and pliability shall be unaffected when tested in accordance with ASTM D 146.

2.1.2.3 Self-adhering Membrane Accessories

Two component urethane, mastic and primer shall be as approved by the membrane manufacturer. Flashing, temporary UV protection and corner fillets shall be as recommended by the membrane manufacturer.

2.1.3 Fasteners

2.1.3.1 Nails

Nails shall be as recommended in writing by the manufacturer of the material they are attaching. Nails shall be of sufficient length to adequately penetrate the roof sheathing. Absent manufacturer's recommendations, use the following fasteners.

Copper Flashing: solid copper, Number 11 gauge, 25 mm (1") R/S nails, minimum 8 mm (5/16 inch) head.

Asphalt-saturated felt: 22 mm (7/8") large head, hot dipped galvanized nails.

Batten Strips: 44 mm (1-3/4") hot dipped galvanized nails

2.1.3.2 Screws

Screws shall be as recommended in writing by the tile manufacturer for roofs in high wind areas or roof elevations above 12 000 mm (40 feet). Field, fitting and trim tile (all locations):

Non-corrosive gripdeck type screws, sized to provide slight penetration through the underside of the wood decking.

2.1.3.3 Miscellaneous Fasteners

Miscellaneous fasteners may include but are not limited to: wind locks, hurricane clips, tile attachment brackets, deck anchor systems, and flashing cleats. Fasteners shall be made of solid copper (wind locks and hurricane clips can be made of stainless steel).

2.1.4 Flashing

Eave and valley flashing shall be 0.57 kg (20 ounce), light cold-rolled temper (H00) copper conforming to ASTM B 370. Eave flashing minimum width shall be 200 mm (8 inches). Valley flashings shall be 600 mm (24 inches) minimum width. All other flashings shall be minimum 0.46 kg (16 ounce) soft tempered copper. Like metals shall be used on all components of fastening systems and flashing in order to avoid galvanic action. Flashing shall be in accordance with the requirements as specified in Section 07600 SHEET METALWORK, GENERAL.

2.1.5 Concealed Sealant

Concealed sealants for gable rakes, ridges, stringers and other conditions shall be non-running, heavy body plastic cement composed of ingredients complying with ASTM D 2822.

2.1.6 Exposed Sealant

Exposed sealants shall be elastomeric type in accordance with ASTM C 920.

2.1.7 Mortar and Grout

Mortar and/or grout used for filling the openings of cut valley tiles shall consist of 1 part mortar mix meeting ASTM C 387 for Type "N" mortar and 1 part surface bonding cement meeting ASTM C 887. Exposed mortar/grout shall be colored to match the color of the tile.

2.1.8 Wood Strips

Wood strips for nailers, battens, cant strips, and eave strips shall be of pressure treated Douglas fir. Sizes and lengths shall be provided per tile manufacturer's installation details and approved shop drawings.

2.1.9 Adhesives

Adhesives used to secure cut sections of field, fitting or trim tiles at roof edges or valleys shall be as recommended in writing by the tile manufacturer.

2.1.10 Hat Channels

Hat channels shall be 22 gauge, hot-dip galvanized steel, meeting all material requirements specified in section: Cold-Formed Steel Framing. Hat channels shall be used in place of wood strips for nailers, battens, cant strips, eave strips and similar concrete tile support

members at Barrack and Soldier Community Building roofs. Hat channel profile shall be as recommended by the roofing manufacturer for proper support and restraint of concrete tile.

2.1.11 Batten Shims

Shims used for elevating battens shall be fabricated of non-wood, decay resistant material that is dimensionally stable when exposed to water and the anticipated roof deck temperature range. Shims shall provide a nominal 10 mm gap between underlayment and bottom of batten to promote free drainage of water and debris. Minimum size of shims shall match the width of the batten and be 50 mm minimum in length.

PART 3 EXECUTION

3.1 PROTECTION OF ROOF SURFACES

Equipment (such as padded ridge ladders) and techniques shall be used which prevent damage to roof as a result of foot or material traffic. General access to work areas shall not be across finished sections of the roof. Contractor shall be responsible for controlling breakage of tile. The progression of work shall be laid out and presented to the Contracting Officer to prevent other trades from working on or above completed roofing. Personnel who are working on the roof shall have proper shoes that will not damage tiles. Shoe soles shall be made of a material that will aid in preventing falls. All construction that may be damaged by roof installation, such as gutters and downspouts, shall not be installed prior to roof completion.

3.2 PREPARATION OF SURFACES

Prior to commencing roof installation, verify that all work performed by other trades, such as flashing and EIFS, is complete and secure. Confirm that all adjoining work is completed such that no additional work must be staged from the completed tile surface. Roof deck surfaces shall be smooth, clean, firm, dry, and free from loose boards, large cracks, and projecting ends that might damage the roofing. Foreign particles shall be cleaned from all interlocking areas to ensure proper seating and to prevent water damming. Prior to installation of tile, vents and other projections through roofs shall be properly flashed and secured in position, and projecting nails shall be driven firmly home. Do not begin roof installation before all vents and miscellaneous penetrations through the roof are complete and secured from movement. Coordinate installation of flashing required for installation of gutters following completion of roof.

NOTE: Roof system varies with building type, see drawings. Company, Battalion and Soldier Community buildings have rigid insulation above the structural deck, see SECTION: ROOF INSULATION. The Barrack roofs are not insulated. Company and Battalion buildings utilize wood strips for nailers, battens and similar members. Barrack and Soldier Community Buildings use metal hat channels for nailers, battens and similar materials. Concrete tile roof system is applied over wood sheathing on all buildings.

3.3 SELF ADHERING MEMBRANE UNDERLAYMENT

3.3.1 Surface Preparation

Dust, dirt, loose nails or other protrusions shall be removed. Priming is not required for wood or metal surfaces but is necessary on concrete or masonry surfaces.

3.3.2 Primer

Primer shall be applied at a coverage rate of 6-9 sq. meters/liter (250-350 sq. ft./gal.) Primer shall be applied by spray or paint roller.

3.3.3 Temperature

Membrane shall be applied only in fair weather when air and surface temperatures are above 5 degrees C. (40 degrees F.)

3.3.4 Membrane Application

Membrane shall be applied according to manufacturer's instructions at eaves, rakes, valleys, parapet walls, ridges, chimney perimeters and roof penetrations. Membrane shall be adhered directly to roof sheathing. Membrane shall not be folded onto an exposed face of the roof edge.

3.3.4.1 Eave and Rake Application

Membrane shall be cut into 3 to 4.5 meter (10 to 15 foot) lengths and shall be re-rolled. The release paper shall be peeled back 300 to 600 mm (1 to 2 feet) and the membrane shall be aligned on the lower edge of the roof and the first 300 to 600 mm (1 to 2 feet) shall be placed. The release paper under the membrane shall be pulled and peeled from the membrane. The membrane shall be pressed in place. Lower edges shall be rolled firmly with a wallpaper or hand roller. Membrane shall be applied to cover the first 900 mm (3 feet) of deck surface from eaves and rakes. Ends and edges of membrane shall be overlapped a minimum of 150 mm. (6 inches.)

3.3.4.2 Valley and Ridge Application

The membrane shall be cut into 1.2 to 1.8 meter (4 to 6 foot) lengths. The release paper shall be peeled and the sheet centered over the valley or ridge, draped and pressed in place working from the center of the valley or ridge outward in each direction. For valleys, membrane shall be applied starting at the low point and working upwards. Sheets shall overlap a minimum of 150 mm. (6 inches.)

3.3.4.3 Vertical Membrane Flashings

Vertical wall installations shall receive primer prior to the application of membrane. Primer shall be applied at a coverage rate of 6-9 sq. meters/L. (250-350 sq. ft./gal.) Membrane shall be turned up walls and dormers as indicated on the drawings, but not less than 150 mm. Vertical membrane terminations shall be mechanically fastened. Vertical terminations shall receive a troweling of mastic as approved by the membrane manufacturer. Membrane may be folded onto the fascia, provided it will be covered by a gutter metal edge or other material.

3.3.4.4 Protection

Elastomeric membrane underlayment shall not be left permanently exposed to sunlight. Membrane shall be covered with exposed roofing materials as soon as possible. Membrane damaged due to exposure to sunlight shall be patched prior to the application of final roof covering.

3.4 ROOFING FELT UNDERLAYMENT

Roofing felt underlayment membrane shall be used on the field of the roof deck. Felt shall be laid in horizontal layers on deck areas to be covered with tile. Two layers of No. 30 felt shall be applied, except at areas previously covered with elastomeric membrane where only one layer of felt is required. Applications shall be overlapped 300 mm (12 inches) on valleys, and ridges. Joints shall be lapped 100 mm (4 inches) horizontally and 150 mm (6 inches) vertically. Felt shall be carried 150 mm (6 inches) up vertical surfaces and 100 mm (4 inches) over eave, rake and valley metal. Edges shall be fastened with hot-dip galvanized, 12 gauge, 22 mm (7/8 inch) head standard roofing nails on 150 mm (6 inch) centers. Felt shall be preserved unbroken, tight and whole. Do not cut felt against self-adhering membrane.

3.5 METAL FLASHING

Metal flashing shall be as shown at intersections of vertical or projecting surfaces through the roof or against which the roof abuts, such as walls, parapets, and sides of chimneys. Flashing installation shall be in accordance with Section 07600 SHEET METALWORK, GENERAL and the written recommendations of the tile manufacturer. Install all flashing in coordination with felt and self-adhering membrane installation to integrate all materials and ensure appropriate laps for drainage and watertight construction. Install 600 mm (24 inches) wide, double ribbed valley flashing at all valleys. Install self-adhering membrane below valley flashing and above eave flashing. Vertical angle flashing shall extend up walls, parapets, chimneys and similar construction as indicated, but not less than 75 mm (3 inches). Counterflashing shall be installed as indicated, but not less than 160 mm (6 inches) above the surface of roof tiles.

3.6 INSTALLATION STANDARDS

Installation of tile, batten strips and accessory items shall be made consistent with the manufacturer's installation instructions, the recommendations of NCRA R&W Manual, SMACNA Architectural Sheet Metal Manual and IBC 2000. Tiles shall be installed to meet loading requirements of a 160 km/hr. (100 miles/hr.) maximum basic wind speed and an average roof height of 14 meters (46 feet).

3.7 INTERLOCKING FLAT SLATE TILE APPLICATION

3.7.1 Roof Membrane Preparation

Prior to the installation, or roof stockpiling, of any battens or tiles on a contiguous roof area, all membranes, felts and flashings in that area shall be completely installed, attached and sealed to form a water tight roof. Roof tiles do not provide a water barrier. The roof system must be water tight prior to initiation of tile installation.

3.7.2 Chalk Lines

Horizontal and vertical guide lines shall be chalked on the roofing felt to assure proper alignment and appearance. The chalk lines shall be spaced by measuring the delivered tiles for average length and width exposures. An exposure length of 6 mm (1/4 inch) beyond the average shall not be exceeded.

3.7.3 Wood Strips/Metal Hat Channels

Battens shall be applied horizontally, equally spaced between the eave and ridge. Coordinate spacing with opening for ridge venting. Wood battens shall be attached with hot-dip galvanized nails, length sized to ensure full penetration of the roof sheathing. Metal battens shall be attached with non-corroding screws, length sized to ensure full penetration of roof sheathing and metal deck. All batten strips shall be shimmed to provide a nominal 10 mm gap between underlayment and the bottom of the batten. Shims shall be spaced at no greater than 400 mm on center along the entire length of the battens and at the ends of each batten piece. If shims are not permanently attached to battens, the battens shall be attached to the roof deck through the shim. Install cant strips at eaves as required to develop initial pitch of first tile course. Install spacer strips at rakes and valleys and other edge flashing conditions as required to maintain a constant surface plane for tile.

3.7.4 Tile Stacking

Stack tile on the roof as indicated by the manufacturer. Do not locate more than ten tile in any single stack. Draw tile randomly from multiple pallets and distribute among roof stacks to maximize color blending across the roof. Do not place concentrated pallet loads or similar large volumes of material on the roof deck.

3.7.5 Tile Application

- a. Tiles shall be laid to straight lines parallel to ground level, lapped 75 mm (3 inches) minimum vertically. Install consistently using left to right or right to left work patterns as appropriate to the tile design.
- b. Each tile shall be fastened with screws as required by each tile shape. Screws shall be long enough to slightly penetrate the bottom side of the sheathing. All tiles shall be mechanically fastened to battens. Loose laid tiles are not acceptable. Attach each tile as it is placed in its final position. Where pre-drilled holes in tiles align with a gap in the batten, drill an offset hole in the tile at least 50 mm away from the original hole. Tiles in the initial row at the eave and rake shall be additionally anchored with a hurricane clip set in a dab of sealant.
- c. Every other field tile shall be set in concealed adhesive. Ensure that adhesive amount and location does not affect drainage or the ability of the tile to seat flat on the tile below.
- d. Screws on tiles overlapping sheet metalwork shall not puncture the sheet metal. Tiles overlapping sheet metal shall be fastened with copper wire and plastic cement.
- e. Gable rakes shall be cemented to field tiles and fastened with screws.

- f. Ridges shall be cemented and fastened with screws in laps and where they rest on roof tiles. Install bird/snow stops between ridge trim and field tiles where ridge is used for attic ventilation. Maintain air gap to ensure ventilation air flow.
- g. Voids at ends of ridges shall be filled with mortar colored to match tile color.
- h. Tile in contact with cement mortar shall be immersed in water for at least 2 minutes before laying.
- i. Ridge angles and ridge terminals shall be mitered on job, screwed or wired, and set in plastic cement.
- j. Flashing at roof rakes without parapet wall shall be developed to prevent wind blown precipitation from entering the roof system at the exposed (open) edge of rake tiles.

3.8 PROTECTION AND REPAIR OF FINISHED ROOFING

Protect finished roofing from damage by other trades. Prohibit foot traffic on completed roof areas. Replace all damaged tiles following the written instructions of the tile manufacturer.

END OF SECTION

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SECTION 07530

ELASTOMERIC ROOFING (EPDM)

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 29/C 29M	(1997) Bulk Density ("Unit Weight") and Voids in Aggregate
ASTM D 448	(1986; R 1993) Sizes of Aggregate for Road and Bridge Construction
ASTM D 4637	(1996) EPDM Sheet Used in Single-Ply Roof Membrane
ASTM E 108	(1996) Fire Tests of Roof Coverings

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P9513	(1996) Loss Prevention Data for Roofing Contractors
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SINGLE PLY ROOFING INSTITUTE (SPRI)

SPRI RP-4	(1997) Wind Design Standard for Ballasted Single-Ply Roofing Systems
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UNDERWRITERS LABORATORIES (UL)

UL 580	(1994; Rev through Feb 1998) Tests for Uplift Resistance of Roof Assemblies
UL 790	(1997; Rev through Jul 1998) Tests for Fire Resistance of Roof Covering Materials
UL 1256	(1998) Fire Test of Roof Deck Constructions

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Roofing System ; G

Drawings showing size of sheets, position of sheets and splices, flashing details, fastening patterns where applicable for insulation and membrane sheets, and expansion joint details. Detail showing construction of water cutoffs to be used at membrane terminations at the end of a day's work to seal the roofing system from water intrusion.

SD-03 Product Data

Installation ; G

Manufacturer's instructions for preparing and installing the membrane, flashings, seams, insulation, nailers and other accessories.

Protection of Finished Roofing ; G

Protection plan showing areas to be protected, type of material used; a plan to protect the membrane from damage until completion of work by other trades, and a description of the method of repairing the roofing.

Inspection ; G

The inspection procedure for substrate suitability including decks, curbs and insulation installation, prior to start of the work. Inspection procedures during and after placement of the membrane, and after completion of work by other trades.

SD-07 Certificates

Materials ; G

Certificates of compliance attesting that the roofing system and materials meet specification requirements. The certificates shall list the components required for the specified fire and wind uplift resistance ratings.

1.3 GENERAL REQUIREMENTS

Elastomeric membrane roofing shall be Ethylene Propylene Diene Monomer (EPDM), fully adhered to the roof surfaces indicated. Walkway area shall be loose-laid and ballasted. Roofing membrane sheet widths shall be consistent with membrane attachment methods and wind uplift requirements, and shall be as large as practical to minimize joints. Membrane shall be free of holes, lumps, other defects and foreign material. Flashing work shall be coordinated to permit continuous membrane installation operations. Applied insulation shall be weatherproofed by the membrane on the same day.

1.4 Delivery and Storage

Materials shall be delivered to the job site in the manufacturer's original, unopened packages, clearly marked with the manufacturer's name, brand name, and description of contents.

Materials other than ballast shall be stored in clean, dry areas. Storage temperatures shall be as specified by the manufacturer. Storage temperature for adhesives shall be between 15 and 27 degrees C. Materials other than ballast stored on the roof shall not exceed one day's supply and shall be distributed so as not to exceed the roof live load capacity. Ballast shall be stored uncovered, shall not be in contact with sod or earth, and shall not be stored on the roof.

1.5 Fire Resistance

The completed roof system shall have a ASTM E 108 (same test as UL 790 and FM P9513, Appendix A) Class A classification, and meet fire test requirements of UL 1256 or FM P9513, Appendix B for roof deck construction. Compliance of each component of the roofing system shall be evidenced by label or by written certification from the manufacturer.

1.6 Wind Uplift Requirements

Fully adhered roofing systems shall have a 90 UL 580 Class Rating or FM P9513, Appendix C Windstorm Classification. Ratings from other independent laboratories may be substituted provided that the tests, requirements and ratings are documented to be equivalent, to the satisfaction of the Contracting Officer. Wind resistance of loose-laid ballasted system shall be in accordance with SPRI RP-4.

1.7 Warranty

Manufacturer's standard material and watertightness warranties for the roofing system shall be provided for not less than 10 years from acceptance of the work. Warranty shall state that manufacturer shall repair or replace the entire affected portion of the roofing system, including insulation and flashing, if the roofing system leaks or allows the insulation beneath the membrane to become wet during the period of the warranty due to defects in materials or workmanship. Warranties shall cover both labor and materials required to effect repair or replacement.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain an inspection procedure to assure compliance of the installed elastomeric roofing with the contract requirements. The procedure shall include a checklist of points to be observed. Any work found not to be in compliance with the contract shall be promptly removed and replaced or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- 1) Observation of environmental conditions; number and skill level of roofing workers; start and end time of various tasks; condition of substrate.
- 2) Verification of compliance of materials before, during and after installation.
- 3) Inspection of insulation, nailers, flashings, penetrations and work requiring coordination with roofing.
- 4) Inspection of membrane placement, splicing, and attachment.
- 5) Inspection of placement of ballast and walkways.

6) Verification of ballast weight.

PART 2 PRODUCTS

2.1 ADHESIVES

Adhesives, splicing cements, solvents, and sealants shall be as certified for use by the membrane manufacturer.

2.2 BALLAST

Ballast shall be hydraulically pressed concrete pavers. Pavers shall be set on polyethylene paver pedestals. Paver's surface shall not vary more than 2 mm in 50 mm. Paver nominal size shall be 600 by 600 by 65 mm. Paver strength shall be 34 MPa concrete maximum w/c ratio of 0.40 and shall not absorb more than 5 percent moisture. Surface shall have a non-slip finish. Paver pedestals shall be manufacturer's standard product and shall be polyethylene. Pedestals shall space concrete pavers 3 mm maximum.

2.3 FASTENERS

Fasteners for sheet-metal flashing shall be corrosion resistant steel annular-type nails or screws. Fasteners for anchoring the roofing membrane shall be as approved by the membrane manufacturer and identical to those used to obtain the wind uplift rating.

2.4 FLASHING

Flashing shall be of ultra-violet resistant, elastomeric materials as recommended by the membrane manufacturer. Prefabricated shaped flashings shall be used where possible. Sheared edges of metal flashings that contact the membrane shall be turned into a tight hem.

2.5 MEMBRANE

Membrane shall conform to ASTM D 4637, Type I EPDM, Grade 1; Class U, 1.52 mm minimum thickness.

2.6 PREFABRICATED ACCESSORIES

Pipe seals and expansion joint covers shall be types and sizes recommended by the membrane manufacturer.

2.7 NON-WOVEN PROTECTION FABRIC

Protection fabric shall be 3 mm thick, non-woven, polyester fabric. Fabric shall not be attached to the membrane. Fabric is to serve as a bearing and abrasion surface for the polyethylene paver pedestals. An integral wearing surface as part of EPDM can substitute for this requirement.

2.8 GROUT

Grout shall conform to SECTION: CAST-IN-PLACE STRUCTURAL CONCRETE. Aggregate shall be round, 10 mm.

2.9 BATTEN STRIPS

Batten strips, if necessary, shall be extruded rubber, plastic or metal as recommended by the membrane manufacturer.

PART 3 EXECUTION

3.1 ENVIRONMENTAL CONDITIONS

Membrane shall not be installed in high wind, inclement weather or when there is ice, frost or moisture on the deck, insulation or membrane. Membrane shall not be installed when air temperature is below the minimum specified by the membrane manufacturer.

3.2 PREPARATION

The substrate of any bay or section of the building shall be complete and suitable for insulation and membrane installation before roofing is begun. Insulation over which elastomeric roofing is installed shall conform to SECTION: ROOF INSULATION. Surfaces against which membrane is applied shall be smooth, clean, and free from dirt, water, dew, oil, grease, sharp edges and construction debris; all joints over 6 mm wide shall be sealed; joints over 13 mm between insulation boards shall be filled with the same insulation. Wood nailers shall comply with SECTION: ROUGH CARPENTRY.

3.3 INSTALLATION

Installation shall comply with the manufacturer's approved instructions, except as otherwise specified.

3.3.1 Flashing

Edges of membrane, projections through the roof and changes in roof planes shall be flashed. The flashing material shall be extended and sealed a minimum of 75 mm on each side of the fasteners which attach the membrane to nailers. The installed flashing shall be fastened at the top of the flashing a maximum of 300 mm on center under metal counter-flashing or cap. Factory prefabricated pipe seals shall be used where possible.

3.3.2 Expansion Joints

Expansion joints shall be covered using prefabricated covers or elastomeric flashing in accordance with the manufacturer's recommendations.

3.3.3 Membrane Installation

Membrane shall be applied in accordance with the manufacturer's instructions and the following requirements. Adjoining sheets comprising the membrane shall be adhered one to another using a butyl-based contact adhesive. Minimum width of the laps shall be 75 mm. A

primer shall be used before applying the contact adhesive if required by the membrane manufacturer. In applying the contact adhesive, the minimum thickness of the wet film shall be in accordance with the membrane manufacturer's recommendations. If manufacturer's recommendations are not available, the minimum thickness shall be 0.6 mm. A wet film thickness gage shall be used to determine wet film thickness. Direction of lap shall be such that water flows over lap. Membrane joints shall be free of wrinkles or fishmouths. Before application of the contact adhesive, the rubber surfaces to be mated shall be well cleaned. Joints shall be inspected over entire length after completion and defective areas shall be resealed and patched. Damaged areas of membrane shall be removed and replaced with new materials, lapping underlying membrane by at least 75 mm on all sides.

3.3.4 Cutoffs

Cutoffs shall be installed if work day is ended or interrupted by bad weather before roof section is complete. The insulation line shall be straightened using loose-laid cut insulation and the membrane shall be sealed to the roof deck. Flutes in metal decking shall be sealed off along the cutoff edge. Membrane shall be pulled free or cut to expose the insulation when resuming work, and cut insulation sheets used for fill-in shall be removed as necessary to maintain the staggered pattern.

3.3.5 Installation of Walkways

Concrete paver walkways shall be installed on pedestals on loose-laid protection fabric extending at least 25 mm beyond the walkway material, and as specified by the manufacturer. Walkway system shall be installed concurrent with membrane to limit membrane uplift. Protect membrane at walkway at all times until paver installation is completed. Inspect roof system as it is installed. Pavers shall be trimmed to fit and of the largest size possible given the adjacent construction. Grout entire perimeter of walkway to lock pavers together.

3.4 PROTECTION OF FINISHED ROOFING

The roofing membrane shall be protected from damage by other trades. After completion of work by other trades, the protection shall be removed and the roof shall be inspected. Any damage shall be repaired in accordance with the recommendations of the roofing manufacturer.

END OF SECTION

SECTION 07600

SHEET METALWORK, GENERAL

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM B 32	(1996) Solder Metal
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM D 226	(1997a) Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
ASTM D 543	(1995) Evaluating the Resistance of Plastics to Chemical Reagents
ASTM D 822	(1996) Conducting Tests on Paint and Related Coatings and Materials Using Filtered Open-Flame Carbon-Arc Exposure Apparatus
ASTM D 828	(1997) Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation-Apparatus
ASTM D 1784	(1999a) Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement

ASTM D 3656	(1997) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns
ASTM D 4022	(1994) Coal Tar Roof Cement, Asbestos Containing
ASTM D 4586	(1993) Asphalt Roof Cement, Asbestos Free
ASTM E 96	(1995) Water Vapor Transmission of Materials

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089	(1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)
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SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual
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1.2 GENERAL REQUIREMENTS

Sheet metalwork shall be accomplished to form weather tight construction without waves, warps, buckles, fastening stresses or distortion, and shall allow for expansion and contraction. Cutting, fitting, drilling, and other operations in connection with sheet metal required to accommodate the work of other trades shall be performed by sheet metal mechanics. Exposed edges shall be hemmed. Bottom edges of exposed vertical surfaces shall be angled to form drips. Flashing at the end of a run shall be formed into a three-dimensional configuration to direct water to the outside of the system. Accessories and other items essential to complete the sheet metal installation, through not specifically indicated or specified, shall be provided. Installation of sheet metal items used in conjunction with roofing shall be coordinated with roofing work to permit continuous roofing operations. Factory fabricated components shall be packed in cartons marked with the manufacturer's name or trademark printed or embossed at frequent intervals for easy identification.

Sheet metal work pertaining to heating, ventilating, and exhaust systems is specified in other sections. Sheet metal materials related to masonry construction are specified in SECTION: MASONRY and SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Materials; G

Drawings of sheet metal items showing weights, gauges or thicknesses; types of materials; expansion-joint spacing; fabrication details; and installation procedures.

SD-03 Product Data

Materials; G

Manufacturer's literature identifying materials, finishes and installation practices with specific locations where the item will be used in the work noted.

SD-14 Samples

Materials;

Samples of materials proposed for use, upon request by the Contracting Officer.

Color Samples; Color samples for parapet cap, downspout and flashings shall be submitted for approval.

Mock Ups;

All sheet metalwork to be used in exterior wall construction shall be included in full scale mock up panels required in SECTIONS: NON-BEARING MASONRY VENEER/STEEL STUD WALLS and EXTERIOR INSULATION AND FINISH SYSTEM.

1.4 DELIVERY, STORAGE, AND HANDLING

Materials shall be adequately packaged and protected during shipment and shall be inspected for damage, dampness, and wet-storage stains upon delivery to the jobsite. Materials shall be clearly labeled as to type and manufacturer. Sheet metal items shall be carefully handled to avoid damage. Materials shall be stored in dry, ventilated areas until immediately before installation.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of sheet metalwork with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- 1) Storage and handling of materials.
- 2) Observation of environmental conditions; number and skill level of sheet metal workers; condition of substrate.
- 3) Verification of compliance of materials before, during, and after installation.

- 4) Inspection of sheet metalwork for proper size and thickness, fastening and joining, and proper installation.
- 5) Shop drawings include explicit identification of coordination with other trades.
- 6) Sample panels are built and provided with all sheet metal work components of the wall construction as indicated.
- 7) Finishes are protected from damage until acceptance.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Lead, lead-coated metal, and galvanized steel shall not be used. Any metal listed by SMACNA Arch. Manual for a particular item may be used, unless otherwise specified or indicated. Materials shall conform to the requirements specified below and to the thicknesses and configurations established in SMACNA Arch. Manual. Different items need not be of the same metal, except that if copper is selected for any exposed item, all exposed items shall be copper.

2.1.1 Accessories

Accessories and other items essential to complete the sheet metal installation, though not specifically indicated or specified, shall be provided.

2.1.2 Aluminum Extrusions

ASTM B 221M (ASTM B 221), Alloy 6063, Temper T5.

2.1.3 Bituminous Cement

Type I asphalt cement conforming to ASTM D 2822 or ASTM D 4586.

2.1.4 Sealant

Unless otherwise specified, sealant shall be an elastomeric weather resistant sealant as specified in SECTION: JOINT SEALING. Plastic hard setting sealants for use with aluminum framing shall be as recommended by the aluminum manufacturer.

2.1.5 Fasteners

Fasteners shall be compatible with the fastened material and shall be the type best suited for the application. Nails shall be barbed, annular thread or screw type. Stainless steel fasteners shall be used for connecting dissimilar metals, and where shown on the drawings. Fasteners used on anodized or painted sheet metal shall be colored to match.

2.1.6 Felt

ASTM D 226, Type I.

2.1.7 Polyvinyl Chloride (PVC) Reglets

ASTM D 1784, Class 14333D, 1.9 mm minimum thickness.

2.1.8 Masonry Reglets

Reglets shall be factory fabricated and shall be the separate top flange and friction fit reglet type. Top flange shall insert into the masonry joint a minimum of 100 mm. The overall depth of the flashing shall be a minimum of 140 mm.

2.1.9 Aluminum Alloy Sheet and Plate

ASTM B 209M (ASTM B 209), form, alloy, and temper appropriate for use, with anodized color coating as indicated on the drawings.

2.1.10 Copper

ASTM B 370, Temper H 00.

2.1.11 Stainless Steel

ASTM A 167, Type 302 or 304; fully annealed, dead soft temper.

2.1.12 Solder

ASTM B 32, 95-5 tin-antimony.

2.1.13 Through-Wall Flashing (at locations other than Masonry and EIFS walls)

- a. Electro-sheet copper not less than 0.14 kg, (5 ounces,) factory coated both sides with acid- and alkali-resistant bituminous compound not less than 1.8 kg per square meter (6 ounces per square foot) or factory covered both sides with asphalt-saturated cotton fabric, asphalt saturated glass-fiber fabric, or with 18 kg reinforced kraft paper bonded with asphalt.
- b. Stainless steel, Type 304, not less than 0.08 mm thick, completely encased by and permanently bonded on both sides to 23 kg high strength bituminized crepe kraft paper, using hot asphalt, heat, and pressure.
- c. Nonreinforced, waterproof, impermeable extruded elastomeric single ply sheeting not less than 0.76 mm (30 mils) thick.
- d. 0.09 kg (Three ounce) copper sheet, with 0.05 mm (2 mils) of dense, clear, polyethylene sheet bonded to each side of the copper.
- e. Use of PVC flashing systems is prohibited.

2.1.14 Louvers

Louvers are specified in SECTION: LOUVERS AND VENTS.

2.1.15 Roof Flashing

- a. Eave and valley flashing shall be 0.57 kg (20 ounce), light cold-rolled temper (H00) copper conforming to ASTM B 370.
- b. All other roof flashing shall be minimum 0.46 kg (16 ounce) soft tempered copper.

In addition, see SECTION: CONCRETE TILE ROOFING for supplemental specification of roof flashing materials and installation requirements.

2.1.16 Through-Wall Flashing (at Masonry and EIFS Walls)

See flashing specified in SECTIONS: MASONRY and NONBEARING MASONRY VENEER/STEEL STUD WALLS.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

Gutters and downspouts shall be designed and fabricated in conformance with SMACNA Arch. Manual. Unless otherwise specified or indicated, exposed edges shall be folded back to form a 13 mm hem on the concealed side, and bottom edges of exposed vertical surfaces shall be angled to form drips. Bituminous cement shall not be placed in contact with roofing membranes other than built-up roofing.

3.2 EXPANSION JOINTS

Expansion joints shall be provided as indicated and constructed as specified in SMACNA Arch. Manual. Expansion joints in continuous sheet metal shall be provided at 12.0 meter intervals for copper and stainless steel and at 9.6 meter intervals for aluminum, except extruded aluminum gravel stops and fasciae that shall have expansion joints at not more than 3.6 meter spacing. Joints shall be evenly spaced. An additional joint shall be provided where the distance between the last expansion joint and the end of the continuous run is more than half the required interval spacing.

3.3 PROTECTION OF ALUMINUM

Aluminum shall not be used where it will be in contact with copper or where it will contact water that flows over copper surfaces. Aluminum that will be in contact with wet or pressure-treated wood, mortar, concrete, masonry, or ferrous metals shall be protected against galvanic or corrosive action by one of the following methods:

3.3.1 Paint

Aluminum surfaces shall be solvent cleaned and given one coat of zinc-molybdate primer and one coat of aluminum paint as specified in SECTION: PAINTING, GENERAL.

3.3.2 Nonabsorptive Tape or Gasket

Nonabsorptive tape or gasket shall be placed between the adjoining surfaces and cemented to the aluminum surface using a cement compatible with aluminum.

3.4 CONNECTIONS AND JOINTING

3.4.1 Soldering

Soldering shall apply to copper, copper clad stainless steel and stainless steel items. Edges of sheet metal shall be pretinned before soldering is begun. Soldering shall be done slowly with well heated soldering irons so as to thoroughly heat the seams and completely sweat the solder through the full width of the seam. Edges of stainless steel to be pretinned shall be treated with soldering acid flux. Soldering shall follow immediately after application of the flux. Upon completion of soldering, the acid flux residue shall be thoroughly cleaned from the sheet metal with a water solution of washing soda and rinsed with clean water.

3.4.2 Riveting

Joints in aluminum sheets 1.0 mm or less in thickness shall be mechanically made.

3.4.3 Seaming

Flat-lock and soldered-lap seams shall finish not less than 25 mm wide. Unsoldered plain-lap seams shall lap not less than 75 mm unless otherwise specified. Flat seams shall be made in the direction of the flow.

3.5 CLEATS

A continuous cleat shall be provided where indicated or specified to secure loose edges of the sheet metalwork. Butt joints of cleats shall be spaced approximately 3 mm apart. The cleat shall be fastened to supporting wood construction with nails evenly spaced not over 300 mm on centers. Where the fastening is to be made to concrete or masonry, screws shall be used and shall be driven in expansion shields set in concrete or masonry. Cleats for fascia anchorage shall be installed to extend below the supporting construction to form a drip and to allow the flashing to be hooked over the lower edge at least 20 mm.

3.6 GUTTERS AND DOWNSPOUTS

3.6.1 Gutters

Gutters shall be installed as indicated. Gutters shall terminate at least 15 mm away from vertical surfaces. Gutters shall be supported by cleats spaced not less than 500 mm apart. Gutters shall be hung with high points at ends or equidistant from downspouts and shall have a slope of not less than 5 mm per meter. Gutter brackets and spacers shall be fastened to roof nailer, or sheathing when a nailer is not present, by screws or deformed shank type nails and shall interlock with or be fastened to the leading edge of gutter. Gutters shall be constructed with an integral outlet tube where drainage is direct to downspouts. Outlet tube shall have a friction fit strainer removable from the gutter. Gutters that terminate at collector

boxes shall have end flanges for positive connection to collector box. Expansion joints in gutters shall be constructed as indicated in SMACNA Arch. Manual.

3.6.2 Downspouts

Downspouts shall be installed as indicated. Downspouts shall be rigidly attached to the building. Attachment shall not penetrate moisture barrier surface of exterior wall construction. Supports for downspouts shall be spaced according to manufacturer's recommendations, but shall at least be provided at the top of each downspout section. Downspouts shall be set plumb and not less than 25 mm from face of wall. Leaders shall collect gutters on overhanging eaves to downspouts. Leaders shall slope at least 5 mm per meter, but not more than a 30 degree slope below horizontal. Leaders shall be riveted to downspouts. Joints between lengths of downspouts shall be made by telescoping the end of the upper lengths at least 20 mm into the lower length. Downspouts shall be terminated neatly into downspout boots with a sealed connection. Provide downspout sampling ports at any downspouts connected to a leaching chamber.

3.6.3 Scupper and Collector Boxes

Boxes shall be shop fabricated using water-tight seaming methods for through wall overflow scuppers as recommended by the SMACNA Arch. Manual. Scupper and collector boxes shall be configured as indicated on the drawings. All edges of the installed boxes shall be sealed in accordance with SECTION: JOINT SEALING after installation.

3.6.4 Scupper Linings

Install scupper linings as detailed and as specified herein. The interior of scupper openings shall be lined with sheet metal. The lining shall be formed to return not less than 25 mm against both faces of the wall or parapet with the outside edges folded under 15 mm less on the top and sides. The perimeter of the lining shall be approximately 15 mm less than the perimeter of the scupper. The top and sides of scuppers on the roof-deck side shall be joined to base flashing by a locked and soldered joint. The bottom edge shall be joined by a locked and soldered joint to the base flashing.

3.7 PARAPET CAPS

Parapet caps shall be shop fabricated in the shapes and sizes indicated on the drawings. Caps shall be formed from sheet material in the gauges indicted by SMACNA Arch. Manual. Lower edges of cap flange pieces shall be folded under 20 mm and formed for a drip edge such that flanges can hook onto continuous sheet metal cleats. Caps shall be formed in sections not exceeding 3 meters in length. Sections of caps shall be joined with a minimum 40 mm high standing seam joint conforming with the SMACNA Arch. Manual. Coping corners shall be fabricated with standing seam joints on a miter. Slope caps back towards the roof as indicated on the drawings. Caps shall be installed with edges hooked over continuous cleats.

3.7.1 Parapet Cap Support

At contractor's option, cap support shall be fabricated of preservative treated wood per SECTION: ROUGH CARPENTRY, or manufacturer's standard type chairs and cleats. Wood shall be sloped to match slope in the caps and shall provide continuous support under the

caps. Manufactured parapet caps shall snap on to an anchor plate and lock into position without the use of exposed fasteners. Finished installations shall be fully weathertight.

3.8 FLASHINGS

Flashings shall be installed at locations indicated and as specified below. Sealing shall be according to the flashing manufacturer's written recommendations. Flashings shall be installed at intersections of roof with vertical surfaces and at projections through roof, except that flashing for heating and plumbing, including piping, roof, and floor drains, and for electrical conduit projections through roof or walls are specified in other sections. Except as otherwise indicated, counter flashings shall be provided over base flashings. Perforations in flashings made by masonry anchors shall be covered up by an application of bituminous plastic cement at the perforation. Flashing shall be installed on top of joint reinforcement. Flashing shall be formed to direct water to the outside of the system. Cap and base flashing for exterior and interior corners shall be factory fabricated units. Corner units shall have mitered joints, shall be installed with 75 mm lap joint over flashings on each side.

3.8.1 Base Flashing

Metal base flashing shall be coordinated with roofing work. Metal base flashing shall be set in plastic bituminous cement over the roofing membrane, nailed to nailing strip, and secured in place on the roof side with nails spaced not more than 75 mm on centers. Metal base flashing shall not be used on built-up roofing.

3.8.2 Counter Flashings

Except as otherwise indicated, counter flashings shall be provided over base flashings. Counter flashing shall be installed as shown on the drawings and where not detailed, as indicated in SMACNA Arch. Manual. Where bituminous base flashings are provided, the counter flashing shall extend down as close as practicable to the top of the cant strip. Counter flashing shall be factory formed to provide spring action against the base flashing.

3.8.3 Stepped Flashing

Stepped flashing shall be installed where sloping roofs surfaced with concrete tiles abut vertical surfaces. Separate pieces of base flashing shall be placed in tile courses. Base flashing shall be at least 100 mm wide on each leg. Stepped counterflashing shall extend at least 200 mm above roof surface. Stepped flashing shall be lapped at least 100 mm at all vertical joints. In other respects, flashing system shall be configured as directed by tile manufacturer's written installation instructions.

3.8.4 Through-Wall Flashing

Through-wall flashing includes sill, lintel, and spandrel flashing. The flashing shall be laid with a layer of mortar above and below the flashing so that the total thickness of the two layers of the mortar and flashing are the same thickness as the regular mortar joints. Joints in flashing shall be lapped and sealed. Flashing shall be one piece for lintels and sills. Provide splice joints and end dams as indicated on the drawings.

3.8.4.1 Lintel Flashing

Lintel flashing shall extend the full length of lintel. Flashing shall extend through the wall one masonry course above the lintels and shall be bent down over the vertical leg of the outer steel lintel angle not less than 50 mm, or shall be applied over top of masonry and precast concrete lintels. Bed joints of lintels at control joints shall be underlain with sheet metal bond breaker. Provide end dams as indicated on drawings, at ends of all lintel flashing within veneer wall construction to stop lateral drainage of water. Provide splice joints as indicated on the drawings.

3.8.4.2 Sill Flashing

Sill flashing shall extend the full width of the sill and not less than 100 mm beyond ends of sill except at control joint where the flashing shall be terminated at the end of the sill. Provide end dams, as indicated on drawings, at edges of all lintel flashing within veneer wall construction to stop lateral drainage of water.

3.8.5 Valley Flashing

Valley flashing shall be installed as specified in SMACNA Arch. Manual, as indicated and as recommended in writing by the concrete tile roofing manufacturer. Provide an inverted "V" joint on the centerline of the flashing. Edges of valley flashing shall extend at least 200 mm under roof tile. Valley flashings shall not be penetrated by fasteners for any other materials.

3.9 FASCIA

Fascia shall be fabricated and installed as indicated and in accordance with SMACNA Arch. Manual.

3.10 REGLETS

Reglets shall be a factory fabricated product of proven design, complete with fittings and special shapes as required. Open-type reglets shall be filled with fiberboard or other suitable separator to prevent crushing of the slot during installation. Reglet plugs shall be spaced not over 300 mm on centers and reglet grooves shall be filled with sealant. Friction or slot-type reglets shall have metal flashings inserted the full depth of slot and shall be lightly punched every 300 mm to crimp the reglet and counter flashing together. Polyvinyl chloride reglets shall be sealed with the manufacturer's recommended sealant.

END OF SECTION

SECTION 07720

FALL PROTECTION ANCHORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A 276	(2000) Stainless Steel Bars and Shapes
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 666	(2000) Annealed or Cold Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7	(1995) Minimum Design Loads for Buildings & Other Structures
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OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

29 CFR – 1926.502	Fall Protection Systems Criteria
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA Arch. Manual	(1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual
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1.2 DESIGN REQUIREMENTS

Fall protection anchors shall be installed along roof ridges at locations indicated on drawings. Anchors shall be installed consistent with OSHA (29 CFR 1926.502) requirements and as indicated. Anchors and attachment to roof substructure shall have a minimum tensile strength of 22.2 kN (5,000 pounds) and shall not deflect more than 1 mm under a 10kN (2,250 pound) load. Anchor shall resist a 1.8 meter free fall of a 100 kg attached load. Anchorage shall incorporate an attachment point for a locking snap hook lanyard. Attachment point shall be at least 200 mm above adjacent roof surface.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fall Protection Anchors; G
Dimensioned drawings indicating location of each anchor including details of construction, and fastening to structural frame of roof. Drawings shall indicate coordination with flashing required to keep roof penetration water tight.

SD-07 Certificates

Fall Protection Anchors; G
Certification that anchors meet all load resistance requirements.

1.4 DELIVERY, STORAGE AND HANDLING

Fall protection anchors shall be protected from moisture and damage. Damaged items shall be removed from site.

1.6 PROJECT/SITE CONDITIONS

Mounting positions shall be field-measured, coordinated with adjacent construction and materials and recorded on shop drawings prior to fabrication. Fabrication shall be scheduled with construction schedule.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of fall protection anchors with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification of anchor installation consistent with shop drawings.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Materials and standard articles shall conform to the requirements indicated in SECTION: MISCELLANEOUS METAL.

2.1.1 Stainless Steel

Shall conform to the applicable sections of ASTM A 167, ASTM A 276 or ASTM A 666, Type 304 or 304L, according to use, type and shape.

2.1.2 Stainless Steel Fasteners

Shall be 300 series stainless steel and shall be used for all connections of stainless steel and also for all connections of dissimilar materials unless otherwise indicated.

2.2 FALL ARREST ANCHORS

Anchors shall be fabricated of stainless steel and shall be assembled to provide the specified load resistance. Anchors shall be a manufacturer's standard product or shall be custom fabricated and tested by an independent agency to demonstrate conformance with specified requirements.

2.3 FABRICATION

Anchors shall be fabricated in accordance with approved shop drawings. Welds and fasteners shall be clean, secure, watertight, and smooth. Edges shall be wired or beaded, where necessary, to ensure rigidity. Joints between sections shall be watertight. Design shall allow for expansion and contraction of adjacent materials. Galvanic action between different metals in direct contact shall be prevented by nonconductive separators.

2.4 FINISH

Anchors shall have a smooth, mill finish with all exposed edges radius to remove all sharp edges or corners.

PART 3 EXECUTION

3.1 PREPARATION

Roof connection point sub-framing, as required to transfer loads to structural framing, shall be installed in accordance with approved shop drawings and manufacturer's recommendations and inspected prior to installation of roof decking and sheathing. Fall protection anchors shall be installed prior to starting work on the installation of concrete tile roofing system. Surrounding roof surfaces shall be protected from damage at all times.

3.2 INSTALLATION

Fall protection anchor installation shall be coordinated with roofing work, and shall be installed in accordance with approved shop drawings, and manufacturer's published

instructions, if a standard product is used. The installation shall be watertight. Aluminum flashing surfaces shall be protected from direct contact with incompatible materials. Aluminum surfaces in contact with sealant shall not be coated with a protective material. Aluminum shall not be used with copper or with water that flows over copper surfaces. Do not install anchors unless they are complete and ready for service the same day.

3.3 PROTECTION

Exposed anchor finish surfaces shall be protected against the accumulation of paint, grime, mastic, disfigurement, discoloration and damage for duration of construction activities.

END OF SECTION

SECTION 07840

FIRESTOPPING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 814	(1997) Fire Tests of Through-Penetration Fire Stops
ASTM E 1399	(1997) Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2000) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 723	(1996; Rev through Dec 1998) Test for Surface Burning Characteristics of Building Materials
UL 1479	(1994; Rev through Feb 1998) Fire Tests of Through-Penetration Firestops
UL 2079	(1998) Tests for Fire Resistance of Building Joint Systems
UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Firestopping Materials ; G

Detail drawings including manufacturer's descriptive data, typical details conforming to UL Fire Resist Dir or other details certified by another nationally recognized testing laboratory, installation instructions or UL listing details for a firestopping assembly in lieu of fire-test data or report. For those firestop applications for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgement, derived from similar UL system designs or other tests, shall be submitted for review and approval prior to installation. Submittal shall indicate the firestopping material to be provided for each type of application. When more than 5 penetrations or construction joints are to receive firestopping, drawings shall indicate location and type of application.

SD-07 Certificates

Firestopping Materials ; G

Certificates attesting that firestopping material complies with the specified requirements. In lieu of certificates, drawings showing UL classified materials as part of a tested assembly may be provided. Drawings showing evidence of testing by an alternate nationally recognized independent laboratory may be substituted.

Installer Qualifications ; G

Documentation of training and experience.

Inspection ; G

Manufacturer's representative certification stating that firestopping work has been inspected and found to be applied according to the manufacturer's recommendations and the specified requirements.

1.3 GENERAL REQUIREMENTS

Firestopping shall consist of furnishing and installing tested and listed firestop systems, combination of materials, or devices to form an effective barrier against the spread of flame, smoke and gases, and maintain the integrity of fire resistance rated walls, partitions, floors, and ceiling-floor assemblies, including through-penetrations and construction joints and gaps. Through-penetrations include the annular space around pipes, tubes, conduit, wires, cables and vents. Construction joints include those used to accommodate expansion, contraction, or wind. Firestopping related to seismic joints is specified in SECTION: SEISMIC CONTROL JOINTS. Firestopping material shall not interfere with the required movement of the joint. Gaps requiring firestopping include gaps between the curtain wall and the floor slab and between the top of the fire-rated walls and the roof or floor deck above.

1.4 STORAGE AND DELIVERY

Materials shall be delivered in the original unopened packages or containers showing name of the manufacturer and the brand name. Materials shall be stored off the ground and shall

be protected from damage and exposure to elements. Damaged or deteriorated materials shall be removed from the site.

1.5 INSTALLER QUALIFICATIONS

The Contractor shall engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary staff, training, and a minimum of 3 years experience in the installation of manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an installer engaged by the Contractor does not in itself confer qualification on the buyer. The Installer shall have been trained by a direct representative of the manufacturer (not distributor or agent) in the proper selection and installation procedures.

1.6 COORDINATION

The specified work shall be coordinated with other trades. Firestopping materials, at penetrations of pipes and ducts, shall be applied prior to insulating, unless insulation meets requirements specified for firestopping. Firestopping materials at building joints and construction gaps shall be applied prior to completion of enclosing walls or assemblies. Cast-in-place firestop devices shall be located and installed in place before concrete placement. Pipe, conduit or cable bundles shall be installed through cast-in-place device after concrete placement but before area is concealed or made inaccessible.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of firestopping with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Inspection of all firestopping installations during application.
- (5) Aesthetic coordination of firestopping with adjacent finishes.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 FIRESTOPPING MATERIALS

Firestopping materials shall consist of commercially manufactured, asbestos-free products complying with the following minimum requirements:

2.1.1 Fire Hazard Classification

Material shall have a flame spread of 25 or less, and a smoke developed rating of 50 or less, when tested in accordance with ASTM E 84 or UL 723. Material shall be an approved firestopping material as listed in UL Fire Resist Dir or by a nationally recognized testing laboratory.

2.1.2 Toxicity

Material shall be nontoxic to humans at all stages of application.

2.1.3 Fire Resistance Rating

Firestopping will not be required to have a greater fire resistance rating than that of the assembly in which it is being placed.

2.1.3.1 Through-Penetrations

Firestopping materials for through-penetrations, as described in paragraph GENERAL REQUIREMENTS, shall provide "F" and "T" fire resistance ratings in accordance with ASTM E 814 or UL 1479. Fire resistance ratings shall be as follows:

- a. Penetrations of Fire Resistance Rated Walls and Partitions: F Rating = Rating of wall or partition being penetrated, minimum of 1 hour.
- b. Penetrations of Fire Resistance Rated Floors, Roof-Ceiling Assemblies and Ceiling-Floor Assemblies: F Rating = 1 hour, T Rating = 1 hour.

2.1.3.2 Construction Joints and Gaps

Fire resistance ratings of construction joints, as described in paragraph GENERAL REQUIREMENTS, and gaps such as those between floor slabs or roof decks and curtain walls shall be the same as the construction in which they occur. Construction joints and gaps shall be provided with firestopping materials and systems that have been tested per ASTM E 119 or UL 2079 to meet the required fire resistance rating. Systems installed at construction joints shall meet the cycling requirements of ASTM E 1399 or UL 2079.

PART 3 EXECUTION

3.1 PREPARATION

Areas to receive firestopping shall be free of dirt, grease, oil, or loose materials which may affect the fitting or fire resistance of the firestopping system. For cast-in-place firestop devices, formwork or metal deck to receive device prior to concrete placement shall be sound and capable of supporting device.

3.2 INSTALLATION

Firestopping material shall completely fill void spaces regardless of geometric configuration, subject to tolerance established by the manufacturer. Firestopping systems for filling floor voids 100 mm or more in any direction shall be capable of supporting the same load as the

floor is designed to support or shall be protected by a permanent barrier to prevent loading or traffic in the firestopped area. Firestopping shall be installed in accordance with manufacturer's written instructions. Tested and listed firestop systems shall be provided in the following locations, except in floor slabs on grade:

- a. Penetrations of duct, conduit, tubing, cable and pipe through floors and through fire-resistance rated walls, partitions, and ceiling-floor assemblies.
- b. Penetrations of vertical shafts such as pipe chases, elevator shafts, and utility chutes.
- c. Gaps at the intersection of floor slabs and curtain walls, including inside of hollow curtain walls at the floor slab.
- d. Gaps at perimeter of fire-resistance rated walls and partitions, such as between the top of the walls and the bottom of roof decks.
- e. Construction joints in floors and fire rated walls and partitions.
- f. Other locations where required to maintain fire resistance rating of the construction.

3.2.1 Insulated Pipes and Ducts

Thermal insulation shall be cut and removed where pipes or ducts pass through firestopping, unless insulation meets requirements specified for firestopping. Thermal insulation shall be replaced with a material having equal thermal insulating and firestopping characteristics. All voids between ductwork and the perimeter of a through wall opening shall be filled with firestopping material.

3.2.2 Fire Dampers

Fire dampers shall be installed and firestopped in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.2.3 Electrical Cables or Conduits

Electrical cables or conduit penetrating fire resistance rated assemblies shall be firestopped as listed by Underwriters Laboratories. Firestopping at penetrations shall also comply with the requirements of NFPA 70.

3.2.4 Compatibility with Finishes

Firestopping materials shall be flush with adjacent surfaces in all areas exposed to view. Where a finish material is applied over the firestopping, care shall be taken to ensure that the firestopping does not affect the plumb/flush surface or adhesion to substrate, of the finish material. Where an escutcheon or cover plate covers a penetration, the firestopping material shall be completely concealed by the cover.

3.3 INSPECTION

Firestopped areas shall not be covered or enclosed until inspection is complete and approved. A manufacturer's representative shall inspect the applications initially to ensure adequate preparations (clean surfaces suitable for application, etc.) and periodically during the work to assure that the completed work has been accomplished according to the manufacturer's written instructions and the specified requirements.

END OF SECTION

SECTION 07900

JOINT SEALING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 570	(1995) Oil- and Resin-Base Caulking Compound for Building Construction
ASTM C 734	(1993) Low-Temperature Flexibility of Latex Sealants After Artificial Weathering
ASTM C 834	(1995) Latex Sealants
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1085	(1991) Butyl Rubber-Based Solvent-Release Sealants
ASTM C 1184	(1995el) Structural Silicone-Sealants
ASTM D 217	(1997) Cone Penetration of Lubricating Grease (IP50/88)
ASTM D 1056	(1998) Flexible Cellular Materials - Sponge or Expanded Rubber
ASTM D 1565	(1999) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Open-Cell Foam)
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

BAY AREA (California) AIR RESOURCES BOARD REGULATION (BAARBR)

Rule 8.51	(2001) Adhesives and Sealant Products
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G"

designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Backing; G

Bond-Breaker; G

Sealant; G

Manufacturer's descriptive data including storage requirements, shelf life, curing time, instructions for mixing and application, and primer data (if required). A copy of the Material Safety Data Sheet shall be provided for each solvent, primer or sealant material.

SD-07 Certificates

Sealant; G

Certificates of compliance stating that the materials conform to the specified requirements.

1.3 ENVIRONMENTAL REQUIREMENTS

The ambient temperature shall be within the limits of 4 to 32 degrees C when the sealants are applied. Do not proceed with installation of sealants under adverse weather condition, or when temperatures are below or above manufacturer's recommended limitations for installation. Proceed with work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Wherever joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in the lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job in the manufacturer's original unopened containers. The container label or accompanying data sheet shall include the following information as applicable: manufacturer, name of material, formula or specification number, lot number, color, date of manufacture, mixing instructions, shelf life, and curing time at the standard conditions for laboratory tests. Materials shall be handled and stored to prevent inclusion of foreign materials. Materials shall be stored at temperatures between 4 and 32 degrees C unless otherwise specified by the manufacturer. Sealant tape shall be handled and stored in a manner that will not deform the tape.

1.5 TEST JOINTS

For all joints exposed to view in the finished construction, a test joint shall be prepared in the actual erected system (or in a test panel mock up where required). Joint shall be prepared complete with all materials as indicated and specified. After a minimum of 24 hours cure

time, the joint shall be inspected by the Contracting Officer's Representative. Inspection shall consider color uniformity and conformance to adjacent material(s), uniformity of tooling, depth of joint and surface finish. Test joints passing inspection shall remain in the finished construction. Any joint materials failing inspection shall be removed and reinstalled. Color alone shall be cause for rejection.

1.6 PROJECT CONDITIONS

1.6.1 Pre-installation Meeting

At the Contractor's direction, the installer, Contract Officer's Representative, sealant manufacturer's technical representative, and other trades involved in coordination with sealant work shall meet with the Contractor at the project site to review the procedures and time schedule proposed for installation of sealants in coordination with other work.

1.6.2 Conditions of other Work

The contractor and installer shall examine the joint surfaces, backing and anchorage of units forming sealant rabbet, and the conditions under which the sealant work is to be performed, and identify any conditions detrimental to the proper and timely completion of the work and performance of the sealants. Do not proceed with the sealant work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

1.6.3 Warranty

Repair or replace elastomeric sealants which fail to perform as air-tight and water-tight joints; or fail in joint adhesion, cohesion or abrasion resistance, weather resistance, extrusion resistance, migration resistance, stain resistance or general durability.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of joint sealing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Sample panels of exterior wall construction include representative sealant joints.
- (5) Verification that correct sealant colors are used in all exposed locations.
- (6) Protection of sealant materials after installation from contamination by any source, including wind blown dust and debris.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

Products shall conform to the respective specifications and other requirements specified. Each container brought to the jobsite with a different sealant formulation shall be marked for the intended use. General properties shall be as follows:

Hardness: As recommended by the manufacturer for application shown, unless otherwise indicated.

Modulus of Elasticity: Provide the lowest available modulus of elasticity which is consistent with exposure to weathering, indentation, vandalism, abrasion, support of loading, and other requirements.

Compatibility: Before purchase of each required material, confirm its compatibility with each other material it will be exposed to in the joint system.

Size and Shape: As shown, or if not shown, as recommended by the manufacturer for the type and condition of joint and for the indicated joint performance or movement.

Grade of Sealant: For each application, unless otherwise indicated, provide the grade of sealant (non-sag, self-leveling, no-track, knife grade, preformed, etc.) as recommended by the manufacturer for the particular condition of installation (location, joint shape, ambient temperature, and similar conditions) to achieve the best possible overall performance. Grades specified herein are for normal conditions for installation.

Where sealant of this section contacts sealants in other SECTIONS, confirm compatibility between sealants and among contacting surfaces to the satisfaction of the Contracting Officers Representative.

Sealants used as filler shall meet the Bay Area Resources Board Regulation 8, Rule 51.

2.1 BACKING

Backing shall be 25 to 33 percent oversize for closed cell and 40 to 50 percent oversize for open cell material, unless otherwise indicated. Backing materials shall be nonabsorbent, nonstaining and compatible with the sealant used. Tube or rod stock shall be rolled into the joint cavity. Preformed support strips for ceramic and quarry tile control-joint and expansion-joint work shall be polyisobutylene or polychloroprene rubber.

2.1.1 Rubber

Cellular rubber sponge backing shall be ASTM D 1056, Type 1, open cell, or Type 2, closed cell, Class A, Grade as recommended by manufacturer for application, round cross section.

2.1.2 Synthetic Rubber

Synthetic rubber backing shall be ASTM C 509, Option I, Type I preformed rods or tubes.

2.1.3 Neoprene

Neoprene backing shall be ASTM D 1056, closed cell expanded neoprene cord Type 2, Class C, Grade 2C2.

2.2 BOND-BREAKER

Bond-breaker shall be as recommended by the sealant manufacturer to prevent adhesion of the sealant to backing or to bottom of the joint.

2.3 PRIMER

Primer shall be non-staining type as recommended by sealant manufacturer for the application. Primer shall have been tested for durability with the sealant to be used and on samples of the surfaces to be sealed.

2.4 CAULKING

Oil and resin-based caulking shall be ASTM C 570, Type 1, Use as recommended by sealant manufacturer.

2.5 SEALANT

2.5.1 Latex

No. 1 sealant, used for interior application only, shall be single component, non-sag, mildew resistant, latex sealant complying with ASTM C 834. Sealant shall be formulated to be paintable. Use only on joints where not more than 7 percent movement from installed dimension is anticipated.

2.5.2 Elastomeric

Elastomeric sealants shall conform to ASTM C 920 and the following:

- a. No. 2 Sealant. Polysulfide Sealant: Type M, Grade N S or P as appropriate, Class 25, Use NT, O.
- b. No. 3 Sealant. Polyurethane sealant: Grade NS, Class 25, Use NT, M, A, and O.
- c. No. 4 Sealant. Silicone sealant: Type S, Grade NS, Class 25, Use NT, G A and O.

2.5.3 Acoustical

No. 5 Sealant. Rubber or polymer-based acoustical sealant shall have a flame spread of 25 or less and a smoke developed rating of 50 or less when tested in accordance with ASTM E 84. Acoustical sealant shall have a consistency of 250 to 310 when tested in accordance with ASTM D 217, and shall remain flexible and adhesive after 500 hours of accelerated weathering as specified in ASTM C 734, and shall be non-staining. Solids content shall be approximately 80 to 90 percent. No oil migration.

2.5.4 Butyl Sealant

No. 6 Sealant. Butyl sealant shall be ASTM C 1085.

2.5.5 Preformed Sealant

Preformed sealant shall be polybutylene or isoprene-butylene based pressure sensitive weather resistant tape or bead sealant capable of sealing out moisture, air and dust when installed as recommended by the manufacturer. At temperatures from minus 34 to plus 71 degrees C, the sealant shall be non-bleeding and shall have no loss of adhesion.

2.5.6 Foam Strip

Foam strip shall be polyurethane foam; cross-section dimensions shall be consistent with manufacturer's recommendations for joint width. Foam strip shall be capable of sealing out moisture, air, and dust when installed and compressed as recommended by the manufacturer. Service temperature shall be minus 40 to plus 135 degrees C. Untreated strips shall be furnished with adhesive to hold them in place. Adhesive shall not stain or bleed into adjacent finishes. Treated strips shall be saturated with butylene waterproofing or impregnated with asphalt.

2.6 BOND-PREVENTATIVE MATERIALS

Bond-preventative materials for use with No. 2 and 3 sealants shall be pressure sensitive adhesive polyethylene tape, aluminum foil or wax paper. At the option of the Contractor, backstop material with bond breaking characteristics may be installed in lieu of bond-preventive materials specified.

2.7 SOLVENTS AND CLEANING AGENTS

Solvents, cleaning agents, and accessory materials shall be provided as recommended by the manufacturer.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Surface Preparation

The surfaces of joints to receive sealant or caulk shall be free of all frost, condensation and moisture. Oil, grease, dirt, chalk, particles of mortar, dust, loose rust, loose mill scale, and other foreign substances shall be removed from surfaces of joints to be in contact with the sealant. Oil and grease shall be removed with solvent and surfaces shall be wiped dry with clean cloths. For surface types not listed below, the sealant manufacturer shall be contacted for specific recommendations. For elastomeric sealants, do not proceed with installation of sealant over joint surfaces that have been painted lacquered, waterproofed or treated with water repellent or other treatment or coating, unless testing has demonstrated that sealant bond is not impaired by coating or treatment.

3.1.2 Concrete and Masonry Surfaces

Where surfaces have been treated with curing compounds, oil, or other such materials, the materials shall be removed by wire brushing. Laitance, efflorescence and loose mortar shall be removed from the joint cavity. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.

3.1.3 Steel Surfaces

Steel surfaces to be in contact with sealant shall be sandblasted or, if sandblasting would not be practical or would damage adjacent finish work, the metal shall be scraped and wire brushed to remove loose mill scale. Protective coatings on steel surfaces shall be removed by sandblasting or by a solvent that leaves no residue.

3.1.4 Aluminum Surfaces

Aluminum surfaces to be in contact with sealants shall be cleaned of temporary protective coatings. When masking tape is used for a protective cover, the tape and any residual adhesive shall be removed just prior to applying the sealant. Solvents used to remove protective coating shall be as recommended by the manufacturer of the aluminum work and shall be non-staining.

3.1.5 Wood Surfaces

Wood surfaces to be in contact with sealants shall be free of splinters and sawdust or other loose particles.

3.2 APPLICATION

Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified. Clean joint surfaces as recommended by sealant manufacturer. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

3.2.1 Masking Tape

Masking tape shall be placed on the finish surface on one or both sides of a joint cavity to protect adjacent finish surfaces from primer or sealant smears. Masking tape shall be removed within 10 minutes after joint has been filled and tooled.

3.2.2 Backing

Backing shall be installed to provide the indicated sealant depth. The installation tool shall be shaped to avoid puncturing the backing.

3.2.3 Bond-Breaker

Bond-breaker shall be applied to fully cover the bottom of the joint without contaminating the sides where sealant adhesion is required.

3.2.4 Primer

Primer shall be used on concrete masonry units, wood, or other porous surfaces in accordance with instructions furnished with the sealant. Primer shall be applied to the joint surfaces to be sealed. Surfaces adjacent to joints shall not be primed.

3.2.5 Sealant

Sealant shall be used before expiration of shelf life. Multi-component sealants shall be mixed according to manufacturer's printed instructions. Sealant in guns shall be applied with a nozzle of proper size to fit the width of joint. Joints shall be sealed as detailed in the drawings. Sealant shall be forced into joints with sufficient pressure to expel air and fill the groove solidly. Sealant shall be installed to the indicated depth without displacing the backing. Unless otherwise indicated, specified, or recommended by the manufacturer, the installed sealant shall be dry tooled to produce a uniformly smooth surface free of wrinkles and to ensure full adhesion to the sides of the joint; the use of solvents, soapy water, etc., will not be allowed. Sealants shall be installed free of air pockets, foreign embedded matter, ridges and sags. Sealer shall be applied over the sealant when and as specified by the sealant manufacturer.

3.2.5.1 No. 2 and 3 Sealants

Compound shall be gun applied with a nozzle of proper size to fit the width of joint indicated and shall be forced into grooves with sufficient pressure to expel air and fill the groove solidly. Sealant shall be uniformly smooth and free of wrinkles. Joints shall be tooled slightly concave after sealant is installed. When tooling white or light colored sealant, dry or water-wet tool shall be used. The following listing indicates the types of applications appropriate for use of No. 2 and 4 sealant compounds as indicated on drawings:

- a. Openings 6 mm and less between walls and partitions and adjacent lockers, casework, door frames, built-in or surface-mounted equipment and fixtures, etc.
- b. Perimeters of frames of doors, windows, and access panels that adjoin exposed interior concrete and masonry surfaces.
- c. Joints between interior masonry walls and partitions and columns, pilasters, concrete walls, or exterior walls unless otherwise detailed.
- d. Seats of metal thresholds for exterior doors.
- e. Joints between metal edge members for acoustical tile and adjoining vertical surfaces.
- f. Other interior locations where small voids between materials require filling for first-class workmanship and painting.

- g. Joints and recesses formed where frames and subsills of windows, doors, louvers and vents adjoin masonry, concrete, or metal frames. Use sealing compound on both exterior and interior surface of exterior wall penetrations.
- h. Masonry joints in which shelf angles occur.
- i. Expansion and control joints.
- j. Interior face of expansion joints in exterior concrete or masonry walls where no metal expansion joint covers are required.
- k. Openings where items pass through exterior walls.
- l. Metal reglets when lead caulking rope is not used where flashing is inserted in to masonry joints, or where flashing is penetrated by coping dowels.
- m. Metal-to-metal joints where sealing or caulking is shown or specified.
- n. Bottoms of exterior doorway frames
- o. Decks and walkways.

3.2.6 Acoustic Sealant

Acoustical sealant shall be applied to all perimeters at sound rated walls and all penetrations through sound rated walls. Acoustical sealant shall be applied only to concealed surfaces. A full bead shall be gunned into joints or openings. Piping and backs of electrical boxes shall be covered with a sealant and perimeters sealed.

3.2.7 Preformed Sealant

Tape shall be placed with removable backing exposed. The backing shall be removed after the tape has been smoothed. Tape shall not be stretched and shall be lapped at least 1 inch at splices.

3.2.8 Foam Strip

In concrete, masonry or plaster work, a primer shall be applied if recommended by the manufacturer. The sealant shall be precompressed to less than the joint width and inserted in the joint cavity.

3.3 SEALANT USE

3.3.1 Joint Types and Sizes

The joint shapes and sizes shall be as indicated on the drawings and specified herein. Joints to be caulked or sealed include but are not necessarily limited to through-bolt holes, windows and window frames, door frames, storefront frames, louver and ventilator frames, framing flashing and openings where items pass through exterior walls or roofs, joints between pre-cast concrete, cast-in-place concrete, brick or combinations of these surfaces and as

otherwise indicated or necessary for watertightness, weatherproofing, or airtightness. Use sealing compound at both exterior and interior surfaces of exterior wall penetrations.

For elastomeric sealants:

	DEPTH OF SEALANT	
	Minimum	Maximum
<u>Metal, Glass or Other Nonporous Surfaces:</u>		
6 mm minimum width	6 mm	6 mm
greater than 6 mm	6 mm	12 mm
 Concrete, Masonry or EIFS		
6 mm minimum width	6 mm	6 mm
6 mm to 12 mm	6 mm	joint width
greater than 12 mm	obtain recommendation from sealant manufacturer	

For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75 percent to 125 percent of joint width. Unless otherwise indicated or specified, anticipated movement in joints should be considered 10 percent of the joint width with a temperature range of not less than 150 degrees F. for metals and 100 degrees F. for other materials.

3.3.2 Joint/Sealant Combinations

Sealants to be used in the various joints indicated shall be as follows:

<u>Material</u>	<u>Sealant No.</u>	<u>Color</u>
Cast-in-place concrete	2	Match Concrete Color
Pre-cast concrete	3	Match Sand Aggregate Color
Brick	3	Match Mortar Color
Windows	3	Match Frame Color
Door/Window/Louver Perimeter at brick	3	Match Mortar Color
Door/Window/Louver Perimeter at pre-cast Concrete	3	match Sand Aggregate Color
Interior joints at Perimeter Of doors and windows	1	Match adjacent wall color

Wood at wood	1	Paint to match if painted surface, or match wood tone or stain color.
Bedding Alum Thresholds	6	Match threshold color, if visible
Wood at dissimilar material	Caulk	Match paint color where visible
Perimeter of sound/	5	Match paint color where acoustic walls visible.

3.4 CLEANING

Do not allow sealants or compounds to overflow or spill onto adjoining surfaces, or to migrate into voids of adjoining surfaces including exposed aggregate panels and similar rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces by either primer or the sealant/caulking compound. The surfaces adjoining the sealed joints shall be cleaned of smears and other soiling resulting from the sealant application as work progresses.

3.5 CURE AND PROTECTION

Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations, to obtain high early bond strength, internal cohesive strength and surface durability. Do not cure in a manner that would significantly alter materials modulus of elasticity or other characteristics. Installer shall advise Contractor of procedures required for curing and protection of sealants and caulking compounds during construction period, so that they shall be without deterioration or damage (other than normal wear and weathering).

3.6 TEST FOR PERFORMANCE

After nominal cure of exterior joint sealants that are exposed to weather, test for water leaks. Flood joint exposure with water directed from a hose held perpendicular to the wall face, 600 mm from joint, connected to a water system with 30 psi minimum static water pressure at the nozzle. Move stream of water along joint at an approximate rate of 7 meters per minute. Test approximately 5 percent of the total joint system, in locations that are typical of every joint condition and that can be inspected for leakage on the opposite face. Conduct test in presence of the Contracting Officer's Representative who will determine actual percentage of joints to be tested and actual period of exposure to water, based on extent of observed leakage, or lack thereof. Repair sealant installation at leaks or, if leakage is excessive, replace sealant installation as directed.

Where nature of observed leakage indicates possibility of inadequate joint bond strength, Contracting Officer will direct that additional testing be performed at a time when joints have been fully cured, followed by natural exposure through both extreme temperatures, and returned to the lowest range of temperature in which it is feasible to conduct testing. Repair or replace work as required. Perform testing at a reasonable time within 12 months of installation date, as directed.

END OF SECTION

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A250.4	(1994) Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors and Hardware Reinforcing
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 153	(2001) Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 591/A 591M	(1998) Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Mass Applications
ASTM A 653/A 653M	(1998) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM C 578	(1995) Rigid, Cellular Polystyrene Thermal Insulation
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM D 2863	(1997) Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index)
ASTM E 84	(2001) Surface Burning Characteristics of Building Materials.
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 2074	(2000) Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies
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DOOR AND HARDWARE INSTITUTE (DHI)

ANSI/DHI A115	(1991) Steel Door Preparation Standards (Consisting of A115.1 through A115.6 and A115.12 through A115.18)
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HOLLOW METAL MANUFACTURER'S ASSOCIATION (HMMA)

HMMA HMM	(1992) Hollow Metal Manual
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
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NFPA 101	(2000) Code for Safety to Life from Fire in Buildings and Structures
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NFPA 105	(1993) Smoke-Control Door Assemblies
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NFPA 252	(1995) Fire Tests of Door Assemblies
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STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100	(1991) Standard Steel Doors and Frames
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SDI 105	(1992) Recommended Erection Instructions for Steel Frames
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SDI 106	Recommended Standard Door Type Nomenclature
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SDI 107	(1984) Hardware on Steel Doors (Reinforcement - Application)
SDI 111B	Recommended Standard Details for Dutch Doors

SDI 111F	Recommended Completed Opening Anchors for Standard Steel Doors and Frames
----------	---

SDI 112	Zinc-Coated (Galvanized/Galvannealed) Standard Steel Doors and Frames
---------	---

SDI 113	(1979) Apparent Thermal Performance for Steel Door and Frame Assemblies
---------	---

SDI 114	(1979) Acoustical Performance for Steel Door and Frame Assemblies
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UNDERWRITERS LABORATORIES INC. (UL)

UL 10B	(1997) Fire Tests of Door Assemblies
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UL 10C

Standard for Safety for Positive Pressure Fire Tests of
Door Assemblies

1.2 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-02 Shop Drawings

Doors; G

Frames; G

Accessories

Weatherstripping

Show elevations, construction details, metal gages, hardware provisions, method of glazing, and installation details.

Schedule of doors; G

Schedule of frames; G

Submit door and frame locations.

SD-03 Product Data

Doors; G

Frames; G

Accessories

Weatherstripping

Submit manufacturer's descriptive literature for doors, frames, and accessories. Include data and details on door construction, panel (internal) reinforcement, insulation, and door edge construction. When "custom hollow metal doors" are provided in lieu of "standard steel doors," provide additional details and data sufficient for comparison to ANSI/SDI 100 requirements.

SD-04 Samples

Factory-applied enamel finish; G

Where colors are not indicated, submit manufacturer's standard colors and patterns to the Contracting Officer for selection.

SD-07 Certificates

Doors and Frames; G

Certification of Oversized Fire Doors: Certificates of inspection shall be in accordance with the requirements of NFPA 80 for fire doors exceeding the sizes for which label service is available.

Certification of Sound Rating: Certification or test report for sound rated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

Certification of Thermal Insulating: Certification or test report for thermal insulated doors shall show compliance with the specified requirements. The certification, or test report, shall list the parameters and the type of hardware and perimeter seals used to achieve the rating.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver doors, frames, and accessories undamaged and with protective wrappings or packaging. Strap knock-down frames in bundles. Provide temporary steel spreaders securely fastened to the bottom of each welded frame. Store doors and frames on platforms under cover in clean, dry, ventilated, and accessible locations, with 6-mm airspace between doors. Do not use non-vented shelters that will promote corrosion. Doors and assembled frames shall be stored in an upright position. Remove damp or wet packaging immediately and wipe affected surfaces dry. Doors and frames with abraded, scarred or rusty areas shall be cleaned and touched up with the paint used for shop priming/painting. Replace doors and frames with dents, creases and similar surface distortion with new materials.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of installed doors and frames with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Observation of environmental conditions and condition of adjacent construction and finishes.
- (2) Protection of all materials during on site storage.
- (3) Verification of compliance of materials with specification before, during and after installation.

- (4) Verification/protection of labeling on all fire rated doors and frames.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 STANDARD STEEL DOORS

Conform to ANSI/SDI 100, except as specified otherwise. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut where indicated. All doors shall have flush end closures at top and bottom. Exterior doors shall have top edge closed and sealed to prevent water intrusion. Doors shall be 44.5 mm thick, unless otherwise indicated. Tolerances for doors and frames shall be uniform within 2 mm for edges and openings and 2 mm for flatness on diagonals. All doors shall have a minimum sound transmission classification of 28. All doors shall have a minimum insulation "R" factor of 2.5.

2.1.1 Door Grades

2.1.1.1 Heavy Duty Doors

Conform to ANSI/SDI 100, Grade II, Model 2, seamless with core construction Type f typical for interior doors, of size(s) and design(s) indicated. Minimum sound transmission class (STC) of door assemblies at barracks room modules shall be 35. Provide Grade II where shown.

2.1.1.2 Extra Heavy Duty Doors

Conform to ANSI/SDI 100, Grade III, Model 2A seamless with core construction Type f for interior doors and Type b for exterior doors, of size(s) and design(s) indicated. Minimum "R" factor of exterior doors shall be 10. The space between the stiffeners shall be filled with mineral-fiber insulation as specified in paragraph "INSULATION CORES." Provide Grade III at all exterior doors, interior doors of stairs, doors separating sections of corridor and where shown.

2.2 CUSTOM HOLLOW METAL DOORS

Provide custom hollow metal doors where nonstandard steel doors are indicated. At the Contractor's option, custom hollow metal doors may be provided in lieu of standard steel doors. Door size(s), design, materials, construction, gages, and finish and certifications shall be as specified for standard steel doors and shall comply with the requirement of HMMA HMM. Fill all spaces in doors with insulation. Close top and bottom edges with steel channels not lighter than 1.5 mm thick. Close top and bottom of exterior doors flush with an additional channel and seal to prevent water intrusion. Prepare doors to receive hardware specified in Section 08710, "Door Hardware." Undercut doors where indicated. Doors shall be 44.5 mm thick, unless otherwise indicated.

2.3 SOUND RATED STEEL DOOR ASSEMBLIES

Conform to SDI 114, except as specified otherwise. Assemblies shall consist of door, frame, and adjustable perimeter seal. The assembly shall have a Sound Transmission Class rating as specified or indicated on drawings when tested in accordance with ASTM E 90.

2.4 ACCESSORIES

2.4.1 Shelves for Dutch Doors

SDI 111B. Fabricate shelves of steel not lighter than 1.5 mm thick (16 gage), of the size indicated. Brackets shall be stock type fabricated of the same metal used to fabricate shelves.

2.4.2 Astragals

For pairs of exterior steel doors that will not have aluminum astragals or removable mullions, as specified in Section 08710, "Door Hardware," provide overlapping steel astragals with the doors. For interior pairs of fire rated doors, provide stainless steel astragals complying with NFPA 80 for fire rated assemblies.

2.4.3 Moldings

Provide moldings around glass of interior and exterior doors and louvers of interior doors. Provide nonremovable moldings on outside of exterior doors and on corridor side of interior doors. Other moldings may be stationary or removable. Secure inside moldings to stationary moldings, or provide snap-on moldings. Muntins shall interlock at intersections and shall be fitted and welded to stationary moldings.

2.4.4 Exterior Louvers

Louvers shall be inverted "Z" type with minimum of 55 percent net-free opening. Weld or tenon louver blades to continuous channel frame and weld assembly to door to form watertight assembly. Form louvers of hot-dip galvanized steel of same gage as door facings. Louvers shall have steel-framed insect screens secured to room side and readily removable. Provide aluminum wire cloth, 7 by 7 per 10 mm or 7 by 6 per 10 mm mesh, for insect screens. Net-free louver area to be before screening.

2.5 INSULATION CORES

Insulated cores shall be of type and minimum "R" value specified, in accordance with SDI 113 and shall conform to:

- a. (Exterior Doors) Rigid Polyurethane Foam: ASTM C 591, Type 1 or 2, foamed-in-place or in board form, with oxygen index of not less than 22 percent when tested in accordance with ASTM D 2863. Minimum "R" value of 10. Insulation shall be permanently bonded to each face panel. Flame spread rating shall be not more than 75 with a smoke development factor of not more than 150 when tested in accordance with ASTM E 84.
- b. (Interior Doors) Mineral Fiber or Fiberglass: ASTM C 665, Type I.

2.6 STANDARD STEEL FRAMES

Conform to ANSI/SDI 100, except as otherwise specified. Form frames to sizes and shapes indicated, with welded corners or knock-down field-assembled corners as specified by location. Provide steel frames for doors, transoms, sidelights, cased openings, and interior glazed panels, unless otherwise indicated.

2.6.1 Welded Frames

Continuously weld frame faces at corner joints. Mechanically interlock or continuously weld stops and rabbets. Grind welds smooth. Welded frames shall be used at all exterior doors, all doors on a corridor or hallway, transoms, sidelights, cased openings and interior glazed panels. All exterior frames shall be 14 gage, hot dip galvanized.

2.6.2 Knock-Down Frames

Design corners for simple field assembly by concealed tenons, splice plates, or interlocking joints that produce square, rigid corners and a tight fit and maintain the alignment of adjoining members. Provide locknuts for bolted connections.

2.6.3 Mullions and Transom Bars

Mullions and transom bars shall be closed or tubular construction and shall member with heads and jambs butt-welded thereto. Bottom of door mullions shall have adjustable floor anchors and spreader connections.

2.6.4 Stops and Beads

Glazing requirements are specified in SECTION: GLASS AND GLAZING. Form stops and beads from 0.9 mm thick steel. Provide for glazed and other openings in standard steel frames. Secure beads to frames with oval-head, countersunk Phillips self-tapping sheet metal screws or concealed clips and fasteners. Space fasteners approximately 300 to 400 mm on centers. Miter molded shapes at corners. Miter square or rectangular beads at corners. Stops and beads shall not extend beyond the door face.

2.6.5 Cased Openings

Fabricate frames for cased openings of same material, gage, and assembly as specified for metal door frames, except omit door stops and preparation for hardware.

2.6.6 Anchors

Provide anchors to secure the frame to adjoining construction. Provide steel anchors, zinc-coated or painted with rust-inhibitive paint, not lighter than 1.2 mm thick. Anchors to be built into exterior walls shall be galvanized after fabrication to comply with ASTM A 153, Class B.

2.6.6.1 Wall Anchors

Provide at least three anchors for each jamb. For frames that are more than 2 285 mm in height, provide one additional anchor for each jamb for each additional 760 mm or fraction thereof.

- a. Masonry: Provide anchors of corrugated or perforated steel straps or 5 mm diameter steel wire, adjustable or T-shaped;
- b. Stud partitions: Weld or otherwise securely fasten anchors to backs of frames. Design anchors to be fastened to closed steel studs with sheet metal screws, and to open steel studs by wiring or welding;
- c. Completed openings: Secure frames to previously placed concrete or masonry with expansion bolts in accordance with SDI 111F; and
- d. Solid plaster partitions: Secure anchors solidly to back of frames and tie into the lath. Provide adjustable top strut anchors on each side of frame for fastening to structural members or ceiling construction above. Size and type of strut anchors shall be as recommended by the frame manufacturer.

2.6.6.2 Floor Anchors

Provide floor anchors drilled for 10-mm anchor bolts at bottom of each jamb member.

2.7 FIRE AND SMOKE DOORS AND FRAMES

Conform to NFPA 80 and NFPA 105 and this specification. The requirements of NFPA 80 and NFPA 105 shall take precedence over details indicated or specified.

2.7.1 Labels

Fire doors and frames shall bear the label of Underwriters Laboratories, Inc. (UL), Factory Mutual Engineering Corporation (FM), or Warnock Hersey International (WHI) attesting to the rating required. Testing shall be in accordance with NFPA 252 or UL 10B. Labels shall be metal with raised letters, and shall bear the name or file number of the door and frame manufacturer. Labels shall be permanently affixed at the factory to frames and to the hinge edge of the door. Door labels shall not be painted. Protect labels with barrier tape or film until all painting has concluded.

2.7.2 Oversized Doors

For fire doors and frames which exceed the size for which testing and labeling are available, furnish certificates stating that the doors and frames are identical in design, materials, and construction to a door which has been tested and meets the requirements for the class indicated.

2.7.3 Astragal on Fire and Smoke Doors

On pairs of labeled fire doors, conform to NFPA 80 and UL requirements. On smoke control doors, conform to NFPA 105.

2.7.4 Temperature Rate of Rise Doors

Fire door assemblies located in exit enclosures shall have a maximum transmitted temperature end point of not more than 450 degrees F above ambient at the end of 30 minutes of standard fire test exposure. Door labels on rate of rise doors shall indicate conformance.

2.8 WEATHERSTRIPPING

As specified in Section 08710, "Door Hardware."

2.8.1 Integral Gasket

Black synthetic rubber gasket with tabs for factory fitting into factory slotted frames, or extruded neoprene foam gasket made to fit into a continuous groove formed in the frame, may be provided in lieu of head and jamb seals specified in Section 08710, "Door Hardware." Insert gasket in groove after frame is finish painted. Air leakage of weatherstripped doors shall not exceed 5.48×10^{-5} cubic meters per second of air per square meter of door area when tested in accordance with ASTM E 283.

2.9 HARDWARE PREPARATION

Reinforce, drill, and tap doors and frames to receive mortised and concealed finish hardware from templates provided by hardware supplier(s). Prepare doors and frames for hardware in accordance with the applicable requirements of SDI 107 and ANSI/DHI A115. Where combination closer/stop is scheduled, provide 5 mm x 300 mm x width of jamb concealed plate reinforcement. Drill and tap for surface-applied hardware at the project site, except for fire rated doors that shall not be modified on site. Build additional reinforcing for surface-applied hardware into the door at the factory. Locate hardware in accordance with the requirements of ANSI/SDI 100, as applicable. Steel plaster guards shall be provided for all mortised cutouts. Punch door frames, with the exception of frames that will have weatherstripping, to receive a minimum of two rubber or vinyl door silencers on lock side of single doors and two silencers for each leaf at heads of double doors. Set lock strikes out to provide clearance for silencers.

2.10 FINISHES

2.10.1 Factory-Primed Finish

Unless specified otherwise, phosphate treat and factory prime metal doors and frames as specified in ANSI/SDI 100. Where coating is removed by welding, apply touchup of factory primer.

2.10.2 Hot-Dip Zinc-Coated and Factory-Primed Finish

Fabricate exterior and laundry room, toilet room, locker and shower area doors and frames from galvanized steel, ASTM A 653/A 653M, Coating Designation G90. Repair damaged zinc-coated surfaces by the application of zinc dust paint. Phosphate treat and factory prime zinc-coated surfaces as specified in ANSI/SDI 100.

2.10.3 Painting

Field painting of doors and frames shall be as specified in SECTION: PAINTS and COATINGS. During painting of doors and frames, fire rating labels shall be protected at all times.

2.11 FABRICATION AND WORKMANSHIP

Finished doors and frames shall be strong and rigid, neat in appearance, and free from defects, waves, scratches, cuts, dents, ridges, holes, warp, and buckle. Molded members shall be clean cut, straight, and true, with joints coped or mitered, well formed, and in true alignment. Dress exposed welded and soldered joints smooth. Design door frame sections for use with the wall construction indicated. Corner joints shall be well formed and in true alignment. Conceal fastenings where practicable. Design frames in exposed masonry walls or partitions to allow sufficient space between the inside back of trim and masonry to receive caulking compound.

2.11.1 Grouted Frames

For frames to be installed in exterior walls and to be filled with mortar or grout, fill the stops with strips of rigid insulation to keep the grout out of the stops and to facilitate installation of stop-applied head and jamb seals.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Frames

Set frames in accordance with SDI 105. Plumb, align, and brace securely until permanent anchors are set. Anchor bottoms of frames with expansion bolts or powder-actuated fasteners. Build in or secure wall anchors to adjoining construction. All frames shall be grouted. Backfill frames in exterior walls with mortar. Fill frames in interior walls with gypsum type grout. At exterior locations and interior wet areas (toilet rooms, shower rooms, locker rooms, janitor closets, bathrooms, etc.) coat inside of frames with corrosion-inhibiting bituminous material. For frames in exterior walls, ensure that stops are filled with rigid insulation before grout is placed.

3.1.2 Doors

Hang doors in accordance with clearances specified in ANSI/SDI 100. After erection and glazing, clean and adjust hardware.

3.1.3 Fire and Smoke Doors and Frames

Install fire doors and frames, including hardware, in accordance with NFPA 80. Install smoke doors and frames in accordance with NFPA 80 and NFPA 105.

3.2 PROTECTION

Protect doors and frames from damage. Repair damaged doors and frames prior to completion and acceptance of the project or replace with new, as directed. Wire brush rusted frames until rust is removed. Clean thoroughly. Apply an all-over coat of rust-inhibitive paint of the same type used for shop coat.

3.3 CLEANING

Upon completion, clean exposed surfaces of doors and frames thoroughly. Remove mastic smears and other unsightly marks.

3.4 METRIC CONVERSION SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

<u>PRODUCTS</u>	<u>INCH-POUND</u>	<u>METRIC</u>
Door thickness	1 3/4 inches	44.5 mm
Steel channels	16 gage	1.5 mm
Steel Sheet	23 gage	0.7 mm
	20 gage	0.9 mm
	18 gage	1.2 mm
	16 gage	1.5 mm
Anchor bolts	3/8 inches	10 mm

END OF SECTION

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SECTION 08120

ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

THE ALUMINUM ASSOCIATION, INCORPORATED (AA)

AA 45 (1980) Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 603.8 (1992; Addendum 1993) Pigmented Organic Coatings on Extruded Aluminum

AAMA 605.2 (1992; Addendum 1995) High Performance Organic Coatings on Architectural Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997; Rev. A) Carbon Structural Steel

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221M (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM E 283 (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 331 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

1.2 PERFORMANCE REQUIREMENTS

1.2.1 Structural

Shapes and thicknesses of framing members shall be sufficient to withstand a design wind load of not less than 1.8 kilopascals with a deflection of not more than 1/175 times the length of the member and a safety factor of not less than 1.65. Provide glazing beads, moldings, and trim of not less than 1.25 mm nominal thickness. Components and structural attachment shall be designed to resist lateral and uplift seismic forces consistent with Army TI-809-04 (seismic use group: 1, short period spectral acceleration: 125% G, one second period spectral acceleration: 40% G, site class: D).

1.2.2 Air Infiltration

When tested in accordance with ASTM E 283, air infiltration shall not exceed 2.63 by 10-5 cms per square meter (0.06 cubic feet per minute per square foot) of fixed area at a test pressure of 0.30 kPa 80 kilometers per hour wind speed).

1.2.3 Water Penetration

When tested in accordance with ASTM E 331, there shall be no water penetration at a pressure of 0.38 kPa of fixed area.

1.2.4 Thermal Movement

Provide and make allowances for the noiseless contraction and expansion of all components and materials, over an ambient temperature range of 135 degrees F without buckling, opening of joints, glass breakage, undue stress on fasteners, or any detrimental effects to the storefront assemblies, related components and adjacent structural and/or building elements.

1.2.5 Wind Load Deflection/Building Movement

The deflection of any metal framing member in a direction normal to the plane of the framing system shall not exceed 1/175 of its clear span, or 19 mm, whichever is less. The maximum deflection of any section in the plane of the glass shall not exceed 6 mm. In the plane of the framing system, deflection of framing members shall not reduce the glass or panel bit below 75 percent of the design dimension and shall not reduce the glass or panel edge clearance below 25 percent of the design dimension or 3 mm, whichever is greater. Restrict deflection further if required for assembly and fit of components. At connection points of framing members to anchors, anchor deflection in any direction shall not exceed 1.5 mm. Where connection points are not clearly defined, maximum anchor deflections shall not exceed 1.5 mm.

1.3 SUBMITTALS

Submit the following in accordance with SECTION: "Submittal Procedures."

SD-02 Shop Drawings

Doors and frames; G

Show elevations of each door type with associated glazed areas, size of doors and frames, metal gages, full size sections and details of door and frame construction, methods of anchorage, glazing details, weatherstripping, provisions for and location of hardware, and details of installation.

SD-08 Manufacturer's Instructions

Doors and frames

Submit detail specifications and instructions for installation, adjustments, cleaning, and maintenance.

1.4 DELIVERY, STORAGE, AND HANDLING

Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water, and easily accessible for inspection and handling. Stack materials on non-absorptive strips or wood platforms. Do not cover doors and frames with tarps, polyethylene film, or similar coverings. Protect finished surfaces during shipping and handling using manufacturer's standard method, except that no coatings or lacquers shall be applied to surfaces to which caulking and glazing compounds must adhere.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of aluminum doors and frames with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 DOORS AND FRAMES

Swing-type aluminum doors and frames of size, design, and location indicated. Provide doors complete with frames, framing members, subframes, transoms, adjoining sidelights, adjoining window wall, trim, and accessories.

2.2 MATERIALS

2.2.1 Anchors

Stainless steel or steel with hot-dipped galvanized finish.

2.2.2 Weatherstripping

Continuous wool pile, silicone treated, or type recommended by door manufacturer.

2.2.3 Aluminum Alloy for Doors and Frames

ASTM B 221M/ASTM B 221, Alloy 6063-T5 for extrusions. ASTM B 209M/ASTM B 209, alloy and temper best suited for aluminum sheets and strips.

2.2.4 Fasteners

Screws, nuts, bolts, rivets and other miscellaneous fastening devices incorporated in the door and frame units shall be of aluminum, nonmagnetic stainless steel, or other non-corrosive materials compatible with aluminum and shall be of sufficient strength to perform the functions for which they are used. Do not use exposed fasteners, except where unavoidable and approved. Exposed fasteners, if permitted, shall match the finish of the aluminum surfaces to which applied. Provide galvanic separation between any contacting dissimilar materials.

2.2.5 Structural Steel

ASTM A 36/A 36M, shop primed.

2.2.6 Aluminum Paint

Type as recommended by aluminum door manufacturer.

2.2.7 Sealant

Conform to SECTION: JOINT SEALING.

2.2.8 Separators

Dissimilar metals and dynamic connections shall have contact surfaces separated with high-impact polystyrene or nylon materials with smooth surfaces on both sides and a minimum thickness of 0.8 mm. Dynamic connections shall be a minimum of 1.5 mm thickness.

2.2.9 Glass and Glazing

Conform to SECTION: GLASS AND GLAZING.

2.3 FABRICATION

2.3.1 Aluminum Frames

Extruded aluminum shapes with contours approximately as indicated. Provide removable glass stops and glazing beads for frames accommodating fixed glass. Use countersunk stainless steel Phillips screws for exposed fastenings, and space not more than 300 mm. Mill joints in frame members to a hairline fit, reinforce, and secure mechanically. Alloy and temper recommended by the manufacturer for strength, corrosion resistance, and application of required finish, but not less than 151 MPa ultimate tensile strength and not less than 3 mm thickness, except tubular shapes shall have a combined wall thickness of 5 mm at any location for framing members. Heavier material shall be used if required for strength or fabrication purposes. Alloy and temper shall be such to properly receive the specified finish. Framing sections shall accommodate the glass thickness, gaskets, flashing, sealants, aluminum panels, reinforcing and connected components. Unless indicated otherwise, framing shall be fabricated for inside glazing.

2.3.2 Aluminum Doors

Of type, size, and design indicated and not less than 45 mm thick. Minimum wall thickness, 3 mm, except beads and trim, 1.25 mm. Door sizes shown are nominal and shall include standard clearances as follows: 2.5 mm at hinge and lock stiles, 3 mm between meeting stiles, 3 mm at top rails, 5 mm between bottom and threshold, and 17 mm between bottom and floor. Bevel single-acting doors 2 or 3 mm at lock, hinge, and meeting stile edges. Double-acting doors shall have rounded edges at hinge stile, lock stile, and meeting stile edges.

2.3.2.1 Full Glazed Stile and Rail Doors

Doors shall have medium stiles and rails as indicated. Fabricate from extruded aluminum hollow seamless tubes or from a combination of open-shaped members interlocked or welded together. Fasten top and bottom rail together by means of welding or by 10 or 13 mm diameter cadmium-plated tensioned steel tie rods. Provide an adjustable mechanism of jack screws or other methods in the top rail to allow for minor clearance adjustments after installation.

2.3.2.2 Flush Doors

Use facing sheets with a plain smooth surface. Use one of the following constructions:

- a. A phenolic resin-impregnated kraft paper honeycomb core, surrounded at edges and around glass and louvered areas with extruded aluminum shapes. The impregnation of core shall have a minimum of 18 percent resin content. Provide sheet aluminum door facings, not less than 0.8 mm thick laminated to a 2.5 mm thick tempered hardboard backing, and bond the backing to the honeycomb core. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
- b. A phenolic resin-impregnated kraft paper honeycomb core. Use aluminum facing sheets not less than 1.25 mm thick and form into two pans that will eliminate seams

on the faces. Bond honeycomb core to the face sheets using an epoxy resin or contact cement-type adhesive.

- c. A solid fibrous core, surrounded at edges and around glass and louvered areas and cross-braced at intermediate points with extruded aluminum shapes. Use aluminum facing sheets of not less than 1.25 mm thickness. Bond facing sheets to core under heat and pressure with a thermosetting adhesive, and mechanically lock to the extruded edge members.
- d. Form from extruded tubular stiles and rails mitered at corners, reinforce, and continuously weld at miters. Facing sheets shall consist of 0.8 mm thick sheet aluminum internally reinforced with aluminum channels or Z-bars placed horizontally not more than 400 mm apart and extending full width of panel. Fit spaces between reinforcing with sound-deadening insulation. Facing sheets shall finish flush with faces of stiles and rails and be welded to reinforcing bars or channels and to stiles and rails.
- e. Form from an internal grid system composed of extruded aluminum tubular sections. Provide extruded aluminum tubular sections at both sides, and at perimeters of louver and glass cutouts. Provide three extruded aluminum tubular sections at top and bottom of door. Wall thickness of tubular sections shall be not less than 2.25 mm except that lock rail shall be not less than 3 mm thick, hinge lock rail shall be not less than 3 mm thick, and hinge rail edge shall be not less than 5 mm thick. Fill spaces in door with mineral insulation. Facing sheets shall be of aluminum not less than 2.25 mm thick.
- f. Form from extruded aluminum members at top and bottom, both sides, and at perimeters of louver and glass cutouts. Wall sections of extruded aluminum members shall be not less than 2.25 mm thick and be properly reinforced for application of hardware. Framing members shall be covered on both sides with aluminum facing sheets not less than 2 mm thick. Fill door with foamed-in urethane with a 48 kg per cubic meter density.

2.3.3 Welding and Fastening

Where possible, locate welds on unexposed surfaces. Dress welds on exposed surfaces smoothly. Select welding rods, filler wire, and flux to produce a uniform texture and color in finished work. Remove flux and spatter from surfaces immediately after welding. Exposed screws or bolts will be permitted only in inconspicuous locations, and shall have countersunk heads. Weld concealed reinforcements for hardware in place.

2.3.4 Weatherstripping

Provide on stiles and rails of exterior doors. Fit into slots that are integral with doors or frames. Weatherstripping shall be replaceable without special tools, and adjustable at meeting rails of pairs of doors. Installation shall allow doors to swing freely and close positively. Air leakage of a single leaf weatherstripped door shall not exceed 5.48×10^{-5} cubic meter per second of air per square meter of door area when tested in accordance with ASTM E 283.

2.3.5 Anchors and Structural Support

On the backs of subframes, provide anchors of the sizes and shapes indicated for securing subframes to adjacent construction. Anchor transom bars at ends and mullions at head and sill. Where indicated, reinforce vertical mullions with structural steel members of sufficient length to extend up to the overhead structural slab or framing and secure thereto. [Place anchors as indicated near top and bottom of each jamb and at intermediate points not more than 635 mm apart. Provide for anchorage and fastening to supporting structure and component to component as shown or required. All anchorage and fastenings shall be non-corrosive and compatible with the aluminum, and adjacent components. Type, size, alloy, quantity and spacing of fasteners and anchorage devices shall be as required for performance. Methods of fastening and fasteners shall be concealed to the greatest extent possible. Structural support, bracing and reinforcement for and related to aluminum framing assemblies shall be designed, furnished, and installed to meet performance criteria.

2.3.6 Provisions for Hardware

Hardware is specified in Section 08710, "Door Hardware." Hardware for all aluminum doors shall be coordinated and provided by the door manufacturer. Deliver hardware templates and hardware (except field-applied hardware) to the door manufacturer for use in fabrication of aluminum doors and frames. Cut, reinforce, drill, and tap doors and frames at the factory to receive template hardware. Provide doors to receive surface-applied hardware, except push plates, kick plates, and mop plates, with reinforcing only; drill and tap in the field. Provide hardware reinforcements of stainless steel or steel with hot-dipped galvanized finish, and secure with stainless steel screws. Provide reinforcement in core of flush doors as required to receive locks, door closers, and other hardware. Locks for all doors shall utilize the same interchangeable core and keying system specified in SECTION: DOOR HARDWARE.

2.3.7 Provisions for Glazing

Provide extruded aluminum snap-in glazing beads on interior side of doors. Provide extruded aluminum, theft-proof, snap-in glazing beads or fixed glazing beads on exterior or security side of doors. Glazing beads shall have vinyl insert glazing gaskets. Design glazing beads to receive glass of thickness indicated or specified. Glazing is specified in SECTION GLASS AND GLAZING".

2.3.8 Finishes

Provide exposed aluminum surfaces with factory finish of anodic coating or organic coating.

2.3.8.1 Organic Coating

Clean and prime exposed aluminum surfaces. Provide a high-performance finish in accordance with AAMA 605.2 with total dry film thickness of not less than 0.03 mm 1.2 mils. The finish color shall be as indicated.

PART 3 EXECUTION

3.1 INSPECTION

3.1.1 Pre Installation Inspection

After lines and grades have been established and before beginning installation in any area, contractor and erector shall examine all parts of structure on which the aluminum framing system is to be placed. Should any conditions be found that will prevent proper and timely execution of the work, or endanger its permanency, erection shall not proceed until such conditions are corrected.

3.1.2 Preparation

Verify dimensions of supporting structure by field measurements so that work will be accurately designed, fabricated and fitted to structure. Bench marks for elevations and building line offset marks for alignment shall be established by the Contractor. Should any error be found in their locations, installation or erection will not proceed in affected areas until errors have been corrected.

3.1.3 Embedded Anchors

Provide detailed layout and coordinate placement as required. Coordinate installation and related work with work of other sections and provide items to be placed during installation of the work at proper time to avoid delays in work.. place such items, including inserts and anchors, accurately in relation to final location of components.

3.2 INSTALLATION

Plumb, square, level, and align frames and framing members to receive doors, transoms, adjoining sidelights, and, adjoining window walls. Anchor frames to adjacent construction as indicated and in accordance with manufacturer's printed instructions. Anchor bottom of each frame to rough floor construction with 2.4 mm thick stainless steel angle clips secured to back of each jamb and to floor construction; use stainless steel bolts and expansion rivets for fastening clip anchors. Seal metal-to-metal joints between framing members as specified in SECTION: JOINT SEALING". Hang doors to produce clearances specified in paragraph entitled "Aluminum Doors," of this section. After erection and glazing, adjust doors and hardware to operate properly.

3.3 PROTECTION FROM DISSIMILAR MATERIALS

3.3.1 Dissimilar Metals

Where aluminum surfaces come in contact with metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by one or a combination of the following methods:

- a. Paint the dissimilar metal with one coat of heavy-bodied bituminous paint.
- b. Apply a good quality elastomeric sealant between the aluminum and the dissimilar metal.

- c. Paint the dissimilar metal with one coat of primer and one coat of aluminum paint.
- d. Use a nonabsorptive tape or gasket in permanently dry locations.

3.3.2 Drainage from Dissimilar Metals

In locations where drainage from dissimilar metals has direct contact with aluminum, provide protective paint, to prevent aluminum discoloration.

3.3.3 Masonry and Concrete

Provide aluminum surfaces in contact with mortar, concrete, or other masonry materials with one coat of heavy-bodied bituminous paint.

3.3.4 Wood or Other Absorptive Materials

Provide aluminum surfaces in contact with absorptive materials subject to frequent moisture, and aluminum surfaces in contact with treated wood, with two coats of aluminum paint or one coat of heavy-bodied bituminous paint. In lieu of painting the aluminum, the Contractor shall have the option of painting the wood or other absorptive surface with two coats of aluminum paint and sealing the joints with elastomeric sealant.

3.4 TOLERANCES

Components shall conform to the following erection tolerances. Deviations from established vertical, horizontal or designated position shall not exceed 3 mm per 3.5 meters of length of any member. Maximum offset from true alignment between two abutting members shall not exceed 1.5 mm. Maximum joint gap or opening between removable glazing stops, glass pocket fillers, and/or closures, and adjacent members shall not exceed 0.8 mm. Do not erect members that are warped, bowed, deformed or otherwise damaged or defaced to such extent as to impair strength or appearance. Remove and replace members damaged in process of erection.

3.5 CLEANING

Upon completion of installation, clean door and frame surfaces in accordance with door manufacturer's recommended procedure. Do not use abrasive, caustic, or acid cleaning agents.

3.6 PROTECTION

Protect doors and frames from damage and from contamination by other materials such as cement mortar. All components shall remain free of abrasions and scratches. Prior to completion and acceptance of the work, restore damaged doors and frames to original condition, or replace with new ones.

END OF SECTION

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SECTION 08210

WOOD DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 90	(1997) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
ASTM E 152	(1981; Rev. A) Fire Tests of Door Assemblies
ASTM E 283	(1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ARCHITECTURAL WOODWORK INSTITUTE (AWI)

AWI QS	(1997) Architectural Woodwork Quality Standards and Quality Certification Program
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FOREST STEWARDSHIP COUNCIL (FSC)

(2002) Listing of Certified Wood Products

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3	(1995) High-Pressure Decorative Laminates
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1995) Fire Doors and Fire Windows
NFPA 252	(1995) Fire Tests of Door Assemblies

NATIONAL WOOD WINDOW & DOOR ASSOCIATION (NWWDA)

NWWDA I.S.1-A	(1993) Architectural Wood Flush Doors
NWWDA I.S.4	(1994) Water-Repellent Preservative Non-Pressure Treatment for Millwork
NWWDA I.S.6	(1991) Wood Stile and Rail Doors

NWWDA TM-5	(1990) Split Resistance Test
NWWDA TM-7	(1990) Cycle - Slam Test
NWWDA TM-8	(1990) Hinge Loading Resistance Test

UNDERWRITERS LABORATORIES INC. (UL)

UL 10B	(1997) Fire Tests of Door Assemblies
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1.2 SUBMITTALS

Submit the following in accordance with SECTION: "Submittal Procedures."

SD-02 Shop Drawings

Doors; G

Submit drawings or catalog data showing each type of door unit. Drawings and data shall indicate door type and construction, sizes, thickness, methods of assembly, and glazing,.

SD-03 Product Data

Doors; G

Accessories

Water-resistant sealer

Sample warranty

Sound transmission class rating; G

Fire resistance rating; G

SD-04 Samples

Door finish colors; G

Submit three color samples for approval by the Contracting Officer.

SD-06 Test Reports

Split resistance

Cycle-slam

Hinge loading resistance

Submit split resistance test report for doors tested in accordance with NWWDA TM-5, cycle-slam test report for doors tested in accordance with NWWDA TM-7, and hinge loading resistance test report for doors tested in accordance with NWWDA TM-8.

SD-07 Certificates

For all wood products incorporated as “certified wood” provide evidence of compliance with Forest Stewardship Council (FSC) standards for certified wood. Evidence shall consist of suppliers invoices with certified products indicated on a line item basis.

1.3 GENERAL REQUIREMENTS

Doors shall be of the type, size, and design indicated on the drawings, and shall be the standard products of manufacturers regularly engaged in the manufacture of wood doors. All wood doors shall be installed in metal frames as specified in SECTION: STEEL DOORS AND FRAMES. Hardware, including thresholds, is specified in SECTION: DOOR HARDWARE. Glazing is specified in SECTION: GLASS AND GLAZING.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver doors to the site in an undamaged condition and protect against damage and dampness. Stack doors flat under cover. Support on blocking, a minimum of 100 mm thick, located at each end and at the midpoint of the door. Store doors in a well-ventilated building so that they will not be exposed to excessive moisture, heat, dryness, direct sunlight, or extreme changes of temperature and humidity. Do not store in a building under construction until concrete, masonry work, and plaster are dry. Replace defective or damaged doors with new ones.

1.5 WARRANTY

Warranty shall warrant doors free of defects as set forth in the door manufacturer's standard door warranty.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of wood doors with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) All fire rated doors and frames carry required labels.

- (5) Reinforcement of doors and frames is coordinated for all specified hardware.
- (6) Doors are protected from damage until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 DOORS

Provide solid core doors of the types, sizes, and designs indicated. All wood end grain exposed at edges of doors shall be sealed prior to shipment.

2.1.1 Flush Doors

Flush doors shall conform to NWWDA I.S.1-A. Hollow core doors shall have lock blocks and 25 mm minimum thickness hinge stile. Doors shall be 5-ply or 7-ply construction with faces, stiles, and rails bonded to the cores. Stile edge bands of doors shall be hardwood, of the same species and/or color as the face veneer. No visible finger joints will be accepted in stile edge bands. When used, locate finger-joints under hardware. Composite type doors shall be provided where required to meet fire rating.

2.1.1.1 Interior Flush Doors

For all non-fire rated doors, provide staved lumber core, Type II flush doors conforming to NWWDA I.S.1-A with faces of premium grade red oak. Hardwood veneers shall be rotary cut, random matched.

2.1.1.2 Sliding Closet Doors

Flush doors shall conform to NWWDA I.S.1-A. All doors shall conform to NWWDA I.S.6 premium grade. Doors shall be 35 mm thick. Sliding closet doors shall match appearance of interior flush doors.

2.1.1.3 Acoustical Doors

NWWDA I.S.1-A, solid core, constructed to provide Sound Transmission Class rating of 35 when tested in accordance with ASTM E 90.

2.1.1.4 Composite-Type Fire Doors

Fire rated doors shall be provided at locations indicated on the drawings. Doors specified or indicated to have a fire resistance rating shall conform to the requirements of UL 10B, ASTM E 152, or NFPA 252 and NFPA 80 for the class of door indicated. Affix a permanent metal label with raised or incised markings indicating UL or other nationally recognized testing agency's name and approved hourly fire rating to hinge edge of each door. Face veneer shall match that used on interior flush doors. Composite fire rated doors shall be provided with

vertical stile edges that do not contain fire retardant salts. Vertical stiles shall be of the same species and/or color as the face veneer. Stiles shall be SLM type.

2.2 ACCESSORIES

2.2.1 Door Light Openings

Provide glazed openings with wood moldings of the same specie and color as the face veneers. Provide glazed openings in fire-rated doors with fire rated frames. Glazing is specified in SECTION: GLASS AND GLAZING.

2.2.2 Additional Hardware Reinforcement

Provide fire rated doors with hardware reinforcement blocking, including lock blocks and top, bottom and intermediate rail blocking. Size of lock blocks shall be as required to secure the hardware specified. Reinforcement blocking shall be in compliance with the manufacturer's labeling requirements and shall not be mineral material similar to the core.

2.3 FABRICATION

2.3.1 Marking

Each door shall bear a stamp, brand, or other identifying mark indicating quality and construction of the door.

2.3.2 Quality and Construction

Identify the standard on which the construction of the door was based and identify doors having a Type I glue bond.

2.3.3 Adhesives and Bonds

NWWDA I.S.1-A. Use Type II bond for interior doors. Adhesive for doors to receive a natural finish shall be nonstaining.

2.3.4 Prefitting

At the Contractor's option, doors may be provided factory pre-fit. Doors shall be sized and machined at the factory by the door manufacturer in accordance with the standards under which they are produced. The work shall include sizing, beveling edges, mortising, and drilling for hardware and providing necessary beaded openings for glass and louvers. Provide the door manufacturer with the necessary hardware samples, and frame and hardware schedules as required to coordinate the work.

2.3.5 Finishes

2.3.5.1 Factory Finish

Provide doors finished at the factory by the door manufacturer as follows: AWI QS Section 1500, specification for System No. 4 Conversion varnish alkyd urea or System No. 5 Vinyl catalyzed. The coating shall be AWI QS premium, medium rubbed sheen, open grain effect.

Seal edges, cutouts, trim, and wood accessories, and apply two coats of finish compatible with the door face finish. Touch-up finishes that are scratched or marred, or where exposed fastener holes are filled, in accordance with the door manufacturer's instructions. Match color and sheen of factory finish using materials compatible for field application.

2.3.6 Water-Resistant Sealer

Provide a water-resistant sealer compatible with the specified finish as approved and as recommended by the door manufacturer.

2.4 SOURCE QUALITY CONTROL

Stiles of "B" and "C" label fire doors utilizing standard mortise leaf hinges shall meet the following performance criteria:

- a. Split resistance: Average of ten test samples shall be not less than 225 kilograms load when tested in accordance with NWWDA TM-5.
- b. Cycle-slam: 200,000 cycles with no loose hinge screws or other visible signs of failure when tested in accordance with the requirements of NWWDA TM-7.
- c. Hinge loading resistance: Average of ten test samples shall be not less than 315 kilograms load when tested for direct screw withdrawal in accordance with NWWDA TM-8 using a No. 12, 30 mm long, steel, fully threaded wood screw. Drill 4 mm pilot hole, use 40 mm opening around screw for bearing surface, and engage screw full, except for last 3 mm. Do not use a steel plate to reinforce screw area.

2.5 CERTIFIED WOOD

A minimum of 50 percent of all lumber and panel products provided under this specification shall be certified wood meeting Forest Stewardship Council standards and certification.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Before installation, seal top and bottom edges of doors with the approved water-resistant sealer. Seal cuts made on the job immediately after cutting using approved water-resistant sealer. Fit, trim, and hang doors with a 2 mm minimum, 3 mm maximum clearance at sides and top, and a 5 mm minimum, 6 mm maximum clearance over thresholds. Provide 10 mm minimum, 11 mm maximum clearance at bottom where no threshold occurs. Bevel edges of doors at the rate of 3 mm in 50 mm. Door warp shall not exceed 6 mm when measured in accordance with NWWDA I.S.1-A. Bottom of doors shall be undercut to allow clear door swing over carpeted areas. Vertical edges of doors which have not been rounded or beveled at the factory shall be eased when the doors are installed.

3.1.2 Fire Doors

Install fire doors in accordance with NFPA 80. Operational characteristics shall conform with NFPA 80 and NFPA 101. Follow manufacturer's installation instructions with strict conformance. Do not paint over labels. Factory applied labels shall remain intact where installed. Labeled hinge stile edge and top edge of door shall not be trimmed. Lock stile edge and bottom edge may be trimmed only to the extent recommended by the door manufacturer. Fire doors shall be installed in fire rated and labeled frames. All frames shall be hollow metal type, see SECTION: STEEL DOORS AND FRAMES.

3.2 SCHEDULE

Some metric measurements in this section are based on mathematical conversion of inch-pound measurements, and not on metric measurement commonly agreed to by the manufacturers or other parties. The inch-pound and metric measurements are as follows:

<u>PRODUCTS</u>	<u>INCH-POUND</u>	<u>METRIC</u>
Closet doors	1 1/8 inches	28.5 mm
	1 3/8 inches	35 mm

END OF SECTION

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SECTION 08331

METAL ROLLING COUNTER DOORS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 240/A 240M	(1999b) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 653/A 653M	(1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80	(1999) Fire Doors and Fire Windows
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1.2 GENERAL

Rolling counter doors shall be of the type, size, and design indicated on the drawings, and shall be the standard product of a manufacturer regularly engaged in the production of rolling counter doors. Each door shall be provided with a permanent, easily readable, label showing the manufacturer's name and address and the model number of the door.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings ; G

Drawings showing elevations of each door type, details of anchorage, details of construction, location and description of hardware, shape and thickness of materials, details of joints and connections, and details of guides and fittings. A schedule showing the location of each counter door shall be included with the drawings.

SD-03 Product Data

Rolling Counter Doors ; G

Manufacturer's descriptive data and catalog cuts.

Installation ; G

Cleaning ; G

Manufacturer's preprinted installation and cleaning instructions.

SD-10 Operation and Maintenance Data

Operation ; G

Six complete copies of maintenance instructions listing routine maintenance procedures, possible breakdowns and repairs, troubleshooting guides, and simplified diagrams for the equipment as installed. Spare parts data for each different item of material and equipment specified shall be supplied not later than 10 days prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of service.

1.4 DELIVERY AND STORAGE

Rolling counter doors shall be delivered to the jobsite wrapped in a protective covering with the brands and names clearly marked thereon. Rolling counter doors shall be stored in accordance with the manufacturer's instructions in a dry location that is adequately ventilated and free from dust, water, or other contaminants, and in a manner that permits easy access for inspecting and handling. Doors shall be handled carefully to prevent damage. Damaged items that cannot be restored to like-new condition shall be replaced.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of metal rolling counter doors with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades, particularly fire alarm system.
- (4) Coordination of all required testing.
- (5) Protection of door surfaces and operating systems until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 BASIC COMPONENTS

2.1.1 Curtain

The curtain shall be fabricated of 22 gauge galvanized steel slats conforming to ASTM A 653/A 653M, Coating Designation G60 as specified. Thickness of slat material shall be as required by width of opening. Slats shall be approximately 32 to 38 mm wide with a depth of crown of 13 mm. Alternate slats shall be fitted with end locks to maintain curtain alignment. Bottom of curtain shall be provided with angle or tubular bar reinforcement matching the curtain, and fitted with a resilient bottom seal.

2.1.2 Jamb Guides

Guides shall be of 13 gauge minimum thickness galvanized steel angles conforming to ASTM A 653/A 653M, Coating Designation G60.

2.1.3 Counterbalance Shaft Assembly

The curtain shall be coiled around a steel tube of sufficient thickness and diameter to prevent deflection exceeding 2.5 mm per meter. The barrel shall contain oil tempered helical steel torsion springs capable of sufficient torque to counterbalance the weight of the curtain. Springs shall be calculated to provide a minimum of 7,500 operating cycles (one complete cycle of door operation will begin with the door in the closed position, move to the full open position and return to the closed position). Springs shall be designed for a 25 percent overload factor.

2.1.4 Brackets

Brackets shall be a minimum 12 gauge thickness steel if flat plate, or 16 gauge thickness if there are a minimum of 3 returns of 19 mm width.

2.1.5 Hood

The hood shall be of 24 gauge galvanized steel conforming to ASTM A 653/A 653M, Coating Designation G60.

2.1.6 Locks

The curtain shall be locked at both sides of bottom bar by a chrome-plated cylinder lock keyed into the building keying system. Lock shall be on the room side of the counter door. Lock cylinders and keying shall conform to SECTION: DOOR HARDWARE.

2.2 ROLLING COUNTER DOOR (NON-RATED)

Rolling counter doors shall conform to the requirements specified herein and shall be constructed of galvanized steel curtains, guides and hood components.

2.3 OPERATION

2.3.1 Manual Operation

The curtain shall be operated by means of manual push-up with lift handles or continuous full width lift bar.

2.4 FINISH

Exposed parts of the counter door, including the curtain, bottom rail, guides, and hood shall be of uniform finish and appearance. Steel galvanized coating shall have a prime coat and a baked-on or powder-coated Factory top coat finish. All other steel parts shall be given a shop coat of primer paint standard with the manufacturer. Factory coated color shall be as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Doors shall be installed in accordance with approved detail drawings and manufacturer's instructions. Anchors and inserts for guides, brackets, hardware, and other accessories shall be accurately located. Upon completion, doors shall be free from warp, twist, or distortion. Doors shall be lubricated, properly adjusted, and demonstrated to operate freely.

3.2 CLEANING

Aluminum and stainless steel doors shall be cleaned in accordance with manufacturer's approved instructions.

END OF SECTION

SECTION 08520

ALUMINUM WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 101 (1997) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AAMA 603 (1998) Voluntary Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum

AAMA 605 (1998) voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3656 (1997) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

ASTM E 90 (1999) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions

ASTM E 283 (1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1997e1) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 331 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

ASTM E 413 (1987; R 1999) Rating Sound Insulation

ASTM E 547 (1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential

ASME INTERNATIONAL (ASME)

ASME A39.1 (1995; A39.1a; A39.1b) Safety Requirements for Window Cleaning

INSECT SCREENING WEAVERS ASSOCIATION (ISWA)

ISWA IWS 089 (1990) Recommended Standards and Specifications for Insect Wire Screening (Wire Fabric)

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100 (1997) Procedure for Determining Fenestration Product U-factors

NFRC 200 (1997) Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 101 (1997; Errata 97-1; TIA-97-1) Life Safety Code

SCREEN MANUFACTURERS ASSOCIATION (SMA)

SMA ANSI/SMA 1004 (1987) Aluminum Tubular Frame Screens for Windows

1.2 GENERAL REQUIREMENTS

Windows shall be of the type and size indicated. Glass and ventilating areas of the windows furnished shall be not less than such areas of the windows indicated. The next larger standard-stock size shall be furnished where windows larger than the openings indicated are required to meet this requirements, and it shall be the responsibility of the contractor to provide proper sized openings where windows varying in size from those indicated are furnished. Glass and glazing materials shall conform to SECTION: GLASS AND GLAZING.

1.3 WINDOW PERFORMANCE

Aluminum windows shall meet the following performance requirements. Testing requirements shall be performed by an independent testing laboratory or agency.

1.3.1 Structural Performance

Structural test pressures on window units shall be for positive load (inward) and negative load (outward) in accordance with ASTM E 330. After testing, there shall be no glass breakage, permanent damage to fasteners, hardware parts, support arms or actuating mechanisms or any other damage that could cause window to be inoperable. There shall be no permanent

deformation of any main frame, sash or ventilator member in excess of the requirements established by AAMA 101 for the window types and classification specified in this section.

1.3.2 Air Infiltration

Air infiltration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 283.

1.3.3 Water Penetration

Water penetration shall not exceed the amount established by AAMA 101 for each window type when tested in accordance with ASTM E 547.

1.3.4 Thermal Performance

Thermal transmittance for thermally broken aluminum windows with insulating glass shall not exceed a U-factor of 4.3 W/sq. m K (0.75 Btu/hr-sf-F) determined according to NFRC 100, and a solar heat gain coefficient (SHGC) of 2.3 W/sq. m K (0.40 Btu/hr-sf-F) determined according to NFRC 200. 100. Window units shall comply with the U.S. Department of Energy, Energy Star Window Program for the Northern Climate Zone.

1.3.5 Condensation Index Rating

The condensation index rating shall be 85 as determined using NFRC approved software THERM.

1.3.6 Life Safety Criteria

Windows shall conform to NFPA 101 Life Safety Code when rescue and/or second means of escape are indicated.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Aluminum Windows ; G. Insect Screens ; G

Drawings indicating elevations of window, rough-opening dimensions for each type and size of window, full-size sections, thicknesses of metal, fastenings, methods of installation and anchorage, connections with other work, type of wall construction, size and spacing of anchors, method of glazing, types and locations of operating hardware, mullion details, weatherstripping details, screen details including method of attachment,, and window schedules showing locations of each window type.

SD-03 Product Data

Aluminum Windows ; G

Manufacturer's descriptive data and catalog cut sheets.

Manufacturer's preprinted installation instructions and cleaning instructions.

SD-04 Samples

Aluminum Windows ; G

Manufacturer's standard color samples of the specified finishes.

SD-06 Test Reports

Aluminum Windows ; G

Reports for each type of aluminum window attesting that identical windows have been tested and meet all performance requirements established under paragraph WINDOW PERFORMANCE.

SD-07 Certificates

Aluminum Windows ; G

Certificates stating that the aluminum windows are AAMA certified conforming to requirements of this section. Labels or markings permanently affixed to the window will be accepted in lieu of certificates. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

1.5 QUALIFICATION

Window manufacturer shall specialize in designing and manufacturing the type of aluminum windows specified in this section, and shall have a minimum of 3 years of documented successful experience. Manufacturer shall have the facilities capable of meeting contract requirements, single-source responsibility and warranty.

1.6 DELIVERY AND STORAGE

Aluminum windows shall be delivered to project site and stored in accordance with manufacturer's recommendations. Windows shall be stored off the ground and under weathertight covering. Damaged windows shall be replaced with new windows.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided. A ten year, zero condensation warranty shall be provided for all insulating glass units.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of exterior brick veneer wall construction with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification of proper operation of all venting units.
- (5) Protection of all window surfaces until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 ALUMINUM WINDOW TYPES

Aluminum windows shall consist of complete units including sash, glass, frame, weatherstripping, insect screens, and hardware. Windows shall conform to AAMA 101. Windows shall be thermal break type double-glazed. Thermal barrier shall be neoprene, rigid vinyl, or polyurethane and shall be resistant to weather. Window members shall be heli-arc welded or angle-reinforced and mechanically joined and sealed. Exposed welded joints shall be dressed and finished. Joints shall be permanent and weathertight. Frames shall be constructed to provide a minimum 6 mm thermal break between the exterior and interior frame surfaces. Sash corners shall be internally sealed to prevent air and water leaks. Inner sash shall be key-controlled to swing to the interior to allow maintenance and replacement of the glass. Not less than 2 control keys shall be furnished per window. Operable windows shall permit cleaning the outside glass from inside the building.

2.1.1 Awning/Hopper/Projected Windows

Aluminum awning (A), and projected windows shall conform to AAMA 101 Designation AP-C30 type consisting of hinged ventilators arranged in a single or vertical series within a common frame. Ventilators shall be operated by a device that shall securely close the ventilator at both jambs without the use of additional manually controlled locking device. Operating hardware, except ventilator arms and rotary operators, shall be concealed within frame and sill. Ventilator arms shall be concealed when windows are closed. Awning windows that occur adjacent to an exterior pathway or corridor shall be provided with a stop limiting the window to a maximum projection of 160 mm.

2.1.2 Casement Windows

Aluminum casement (C) windows shall conform to AAMA 101 C-C30 type with ventilators which swing on side jamb. Hinges shall be concealed, four-bar friction type. Four cam lock devices shall secure ventilators tightly in the frame in the closed position. Provide black vinyl mesh insect screens with frame color matching window frame. Operators shall be as required for hinge type.

2.1.3 Fixed Windows

Aluminum fixed (F) windows shall conform to AAMA 101 F-C30 type, non-operable glazed frame, complete with provisions for reglazing in the field.

2.2 WEATHERSTRIPPING

Weatherstripping for ventilating sections shall be of type designed to meet water penetration and air infiltration requirements specified in this section in accordance with AAMA 101, and shall be manufactured of material compatible with aluminum and resistant to weather. Weatherstrips shall be factory-applied and easily replaced in the field. Neoprene or polyvinylchloride weatherstripping are not acceptable where exposed to direct sunlight.

2.3 INSECT SCREENS

Insect screens shall be aluminum window manufacturer's standard design, and shall be provided where scheduled on drawings. Insect screens shall be fabricated of extruded tubular-shaped aluminum frames conforming to SMA ANSI/SMA 1004 and vinyl coated glass screening conforming to ASTM D 3656.

2.4 ACCESSORIES

2.4.1 Fasteners

Fastening devices shall be window manufacturer's standard design made from aluminum or non-magnetic stainless steel, in compliance with AAMA 101. Self-tapping sheet metal screws will not be acceptable for material thicker than 2 mm.

2.4.2 Hardware

Hardware shall be as specified for each window type and shall be fabricated of aluminum, stainless steel, cadmium-plated steel, zinc-plated steel or nickel/chrome-plated steel in accordance with requirements established by AAMA 101.

2.4.3 Window Anchors

Anchoring devices for installing windows shall be made of aluminum, cadmium-plated steel, stainless steel, or zinc-plated steel conforming to AAMA 101.

2.4.4 Remote Window Operators

Remote window operators shall be a complete working system compatible with the window system specified. Manufacturer shall coordinate information with the window supplier. The systems shall consist of a removable crank handle connected to a concealed operator that is

connected to a plastic lined conduit with a flexible steel cable connected to the remote operator at the window. Remote operator shall be a concealed system (local operator at the conduit).

2.5 GLASS AND GLAZING

Aluminum windows shall be designed for inside glazing, field glazing, and for glass types scheduled on drawings and specified in SECTION: GLASS AND GLAZING. Units shall be complete with glass and glazing provisions to meet AAMA 101. Glazing material shall be compatible with aluminum, and shall not require painting.

2.6 FINISH

Exposed surfaces of aluminum windows shall be finished with a two-coat fluoropolymer coating system containing at least 70 percent by weight polyvinylidene fluoride, PVF2 resin, factory-applied, oven-baked, conforming to AAMA 605, with a primer coat of 0.005 to 0.008 mm (0.20 to 0.030 mils) and a color coat of minimum 0.025 mm (1.0 mils), total dry film thickness of 0.030 to 0.033 mm (1.2 to 1.3 mils). Finish shall be free of scratches and other blemishes. Color as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

Aluminum windows shall be installed in accordance with approved shop drawings and manufacturer's published instructions. Aluminum surfaces in contact with masonry, concrete, wood and dissimilar metals other than stainless steel, zinc, cadmium or small areas of white bronze, shall be protected from direct contact using protective materials recommended by AAMA 101. Windows shall be securely anchored in place to a straight, plumb and level condition without distortion. Final adjustment for proper operation of ventilating unit shall be made after glazing. Remote window operators shall conform to manufacturers written recommendations. Window conduit and crank operator shall be concealed. The completed window installation shall be watertight in accordance with SECTION: JOINT SEALING. Glass and glazing shall be installed in accordance with requirements of this section and SECTION: GLASS AND GLAZING.

3.2 ADJUSTMENTS AND CLEANING

3.2.1 Hardware Adjustments

Final operating adjustments shall be made after glazing work is complete. Operating sash or ventilators shall operate smoothly and shall be weathertight when in locked position.

3.2.2 Cleaning

Aluminum window finish and glass shall be cleaned on exterior and interior sides in accordance with window manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring window finish and glass surfaces.

END OF SECTION

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SECTION 08560

PLASTIC (VINYL) WINDOWS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA/NWWDA 101/I.S.2 (1997) Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors

AAMA 1503.1 (1988) Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI A39.1 (1995) Safety Requirements for Window Cleaning

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3656 (1997) Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns

ASTM D 4099 (1995) Poly(Vinyl Chloride) (PVC) Prime Windows/Sliding Glass Doors

ASTM E 283 (1999) Rate of Air Leakage Through Exterior Windows, Curtain Walls and Doors Under Specified Pressure Differences Across the Specimen

ASTM E 330 (1997) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

ASTM E 547 (2000) Water Penetration of Exterior Windows, Skylights, Doors and Curtain Walls by Cyclic Static Air Pressure Differential

1.2 SUBMITTALS

Submit the following in accordance with SECTION: "Submittal Procedures."

SD-02 Shop Drawings

Windows; G

Indicate elevations of windows, full-size sections, thicknesses of PVC, reinforcing members, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, method of glazing, details of operating hardware, method and materials for weatherstripping, method of attaching screens, trim, accessories, installation details, window flashings and other related items.

Schedule of windows; G

Submit with drawings indicating location of each window unit.

SD-03 Product Data

Windows; G

Hardware

Fasteners

Screens

Weatherstripping

Accessories

SD-04 Samples

Windows; G

Submit one full-size window of each type, complete with certification label indicating conformance to AAMA/NWWDA 101/I.S.2 or ASTM D 4099, glazing, hardware, anchors, and other accessories. Where screens or weatherstripping are required, fit sample windows with such items that are to be provided. After approval, install each sample in the work, clearly identified, and record its location.

SD-06 Test Reports

Windows; G

Submit for each window type attesting that identical or larger windows have been tested and meet the requirements specified herein for conformance to AAMA/NWWDA 101/I.S.2 or ASTM D 4099 and the specified minimum Condensation Resistance Factor (CRF).

SD-10 Operation and Maintenance Data

Windows, Data Package 1

Submit data package in accordance with SECTION: "Operation and Maintenance Data."

1.3 QUALITY ASSURANCE

1.3.1 Labels

Each window unit shall bear a certification label from an independent, nationally recognized testing organization validating that the product complies with AAMA/NWWDA 101/I.S.2 for the type, grade, and performance class specified or that the product complies with ASTM D 4099 for the grade specified.

1.3.2 Certification

Certified test reports attesting that the window units meet the requirements of AAMA/NWWDA 101/I.S.2 or ASTM D 4099 as specified will be acceptable in lieu of product labeling or marking.

1.4 DELIVERY, STORAGE, AND HANDLING

Deliver windows to the project site in an undamaged condition. Use care in handling and hoisting windows during transportation and at the job site. Store windows and components out of contact with the ground, under a weathertight covering, to prevent bending, warping, or otherwise damaging the windows. Store windows and components so they will not have to be handled at minus 28 degrees C or colder. Repair damaged windows to an "as new" condition as approved. Provide new units if windows cannot be repaired.

1.5 PROTECTION

Protect finished surfaces during shipping and handling using the manufacturer's standard method, except do not apply coatings or lacquers on surfaces to receive caulking and glazing compounds.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of plastic windows with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Protection of all window surfaces until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR WINDOWS

Windows shall conform to AAMA/NWWDA 101/I.S.2 or ASTM D 4099 and to requirements specified herein. Provide windows of materials, types, grades, performance classes, combinations and sizes indicated or specified. Each window shall be a unit consisting of subframe, frame, sash, glass, hardware, mullions, fins, trim, casing, screen, weatherstripping, anchors and accessories complete. Design windows to accommodate glass, hardware, screens, weatherstripping, and accessories to be furnished. Glass shall be factory or field installed.

2.2 MATERIALS

2.2.1 Windows

Provide rigid Poly Vinyl Chloride (PVC), reinforcing members, fasteners, hardware, weatherstripping, and anchors conforming to AAMA/NWWDA 101/I.S.2 or ASTM D 4099 and as specified herein.

2.2.2 Glass and Glazing

As specified in SECTION:"GLASS AND GLAZING".

2.2.3 Caulking and Sealing

As specified in SECTION: "Joint Sealants."

2.2.4 Insect Screening

ASTM D 3656, Class 2, 18 by 14 mesh, color charcoal.

2.2.5 Accessories

As standard with the manufacturer and as specified herein.

2.3 WINDOW TYPES

Windows shall be of the following types, as indicated.

2.3.1 Awning Windows

AAMA/NWWDA 101/I.S.2, Type A- C 40, Optional Performance Class.

2.3.2 Casement Windows

AAMA/NWWDA 101/I.S.2, Type C- C 40, Optional Performance Class. Ventilators shall be rotary crank operated. Provide ventilators over 1675 mm 66 inches high with two separate locking devices or a two-point locking device operated by rods from a single lever handle. Conceal rods where possible. Provide casement windows in combination with awning windows specified above.

2.3.3 Single Hung Windows

AAMA/NWWDA 101/I.S.2, Type H- C 40, Optional Performance Class.

2.3.4 Fixed Windows

AAMA/NWWDA 101/I.S.2, Type F- C 40, Optional Performance Class.

2.3.5 Construction

Ventilators shall have one or more stabilizing arms attached to the frame when ventilator is opened from top. When ventilator is in the tilt-open position, stabilizing arms shall provide positive positioning of the ventilator.

2.3.6 Hardware

Equip each ventilator with one handle (two handles at single hung windows) to provide opening operation. All vents shall have positive locking device to prevent entrance from the exterior. Single hung windows shall have multiple open positions where vent can be secured.

2.3.7 Performance Requirements

Dual action windows shall meet the primary performance requirements specified in AAMA/NWWDA 101/I.S.2 for Grade and Performance Class C 40, Optional Performance Class.

2.3.7.1 Air infiltration

Shall be no more than 0.22 CFM per foot of overall sash crack at inward pressure of 1.57 per ASTM E 283.

2.3.7.2 Water penetration

Shall be zero at inward test pressure of 3.75 psf per ASTM E 547.

2.3.7.3 Structural performance

There shall be no glass breakage, damage to hardware, permanent deformation at positive and negative test pressure of 37.5 psf per ASTM E 330.

2.4 FABRICATION

Conform to AAMA/NWWDA 101/I.S.2 or ASTM D 4099 and to the requirements specified herein.

2.4.1 Subframes, Mullions and Transom Bars

Provide subframes, transom bars and mullions between multiple window units which meet the design pressure of 192 kilograms per square meter (kg/sq. m). Fabricate mullions and transom bars in such a manner as to permit expansion and contraction between adjoining construction and window units and to form a weathertight joint. Provide mullion covers on the interior and exterior to completely close exposed joints and recesses between window units and to present a neat appearance.

2.4.2 Combination Windows

Windows provided in combination shall be the same grade and performance class and shall be factory assembled. Where factory assembly of individual windows into larger units is limited by transportation considerations, prefabricate, match mark, transport, and field assemble.

2.4.1 Frames and Sash

2.4.1.1 Corners and Reinforcement

Corners of PVC frames and sashes shall be welded. Reinforce frames and sash as necessary to meet the requirements for the performance classes or grades specified herein.

2.4.1.2 Adjustability

Ventilating sash shall be adjustable vertically and horizontally to ensure smooth operation.

2.4.1.3 Drips and Weep Holes

Provide continuous drips over heads of top ventilators (casements and hoppers). Where fixed windows adjoin ventilators, provide continuous drips across tops of fixed windows. Provide drips and weep holes as required to return water to the outside. When manufacturer's frame does not include drips, coordinate a separate drip flashing of same material as window frames.

2.4.1.4 Provisions for Glazing

Design windows and rabbets suitable for glass thickness shown or specified. Design sash for inside double glazing and for securing glass with glazing clips, glazing stops, glazing channels, or glazing gaskets. Glazing area of vents shall be equally proportional to glazing area in fixed units to provide equal sight lines.

2.4.2 Hardware

The item, type, and functional characteristics shall be the manufacturer's standard for the particular window type. Provide hardware of suitable design and of sufficient strength to

perform the function for which it is used. Equip operating ventilators with a lock or latching device which can be secured from the inside. Hardware shall be fabricated of corrosion resistant material. Fasteners of exposed hardware shall match material and finish of attached hardware. All locking hardware shall be certified resistant to forced entry.

2.4.3 Weatherstripping

Provide for ventilating sections of windows to ensure a weathertight seal meeting the infiltration requirements specified in AAMA/NWWDA 101/I.S.2 or ASTM D 4099. Provide easily replaceable factory-applied weatherstripping. Weatherstripping of vent units shall be double or triple type.

2.4.4 Screens

Provide one insect screen for each operable exterior sash or ventilator. Design screens to be rewirable, easily removable from inside the building, and to permit easy access to operating hardware. Screens shall integrate with window frame. Mesh shall fit taut and secure in frame.

2.4.5 Color

Window (PVC) color shall be as indicated on drawings. Color shall be integral or co-extruded to the PVC to prevent heat build-up.

2.4.6 Fasteners

Provide fastener types as standard with the window manufacturer for windows, trim, and accessories.

2.4.7 Accessories

Provide windows complete with clips, fins, anchors, grills, and other appurtenances necessary for complete installation and proper operation.

2.4.7.1 Anchors

Provide concealed anchors of the type recommended by the window manufacturer for the specific type of construction. Anchors and fasteners shall be compatible with the window and the adjoining construction. For each jamb 900 mm or longer, provide a minimum of three anchors located approximately 150 mm from each end and at midpoint. For jambs less than 900 mm long, provide two anchors.

2.4.7.3 Grills

Provide the manufacturer's standard grills for windows as indicated. Grills shall be removable or shall be sealed within insulating glass units. Grill pattern shall be as indicated, providing divided light appearance in fixed and operable sections.

PART 3 EXECUTION

3.1 INSTALLATION

Install in accordance with the window manufacturer's printed instructions and details. Build in windows as work progresses or install without forcing into prepared window openings. Set windows at proper elevation, location, and reveal; plumb, square, level, and in alignment; and brace, strut, and stay properly to prevent distortion and misalignment. Bed screws or bolts in sill members, joints at mullions, contacts of windows with sills, built-in fins, and subframes in mastic sealant of a type recommended by the window manufacturer. Install windows in a manner that will prevent entrance of water and wind. Fasten insect screens securely in place. Fasten hardware to windows.

3.1.1 Anchors and Fastenings

Secure units to each other, to masonry, and to other adjoining construction with clips, fins, screws, or other devices recommended by the window manufacturer. Where window cleaner anchors are provided, anchor windows and mullions to provide safe and adequate support for the window cleaner.

3.2 ADJUSTING

After installation of windows and completion of glazing and field painting, adjust ventilators and hardware to operate smoothly and to provide weathertight sealing when ventilators are closed and locked. Lubricate hardware and operating parts as necessary.

3.3 CLEANING

Remove protective material. Clean interior and exterior surfaces of window units of mortar, plaster, paint spattering spots, and other foreign matter to present a neat appearance, to prevent fouling of weathering surfaces and weatherstripping, and to prevent interference with operation of hardware. Replace stained, discolored, or abraded windows that cannot be restored to their original condition with new windows. Wash all surfaces with mild detergent in warm water applied with soft, clean wiping cloths. Remove dirt from corners, and sill and jamb tracks of venting units. Do not use petroleum or petroleum distillate products of any type on windows.

3.4 PROTECTION

Protect ventilators and operating parts against accumulation of dirt and building materials by keeping ventilators tightly closed and locked to frame.

END OF SECTION

SECTION 08600

SKYLIGHTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA SAA-46 (1978) Standards for Anodized Architectural Aluminum

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 2605 (1998) Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions & Panels

AAMA/WDMA 1600/I.S.7 (2000) Voluntary Specification for Skylights

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 297 (1994) Tensile Strength of Flat Sandwich Constructions in Flatwise Plane

ASTM D 572 (1998; R 1994e1) Rubber Deterioration by Heat and Oxygen

ASTM D 635 (1998) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM D 1002 (1994) Apparent Shear Strength of Single-Lap-Joint Adhesively Bonded Metal Specimens by Tension Loading (Metal-to-Metal)

ASTM D 1003 (1997) Haze and Luminous Transmittance of Transparent Plastics

ASTM D 1037 (1996a) Evaluating Properties of Wood-Base Fiber and Particle Panel Materials

ASTM D 2843 (1993) Density of Smoke from the Burning of Plastics or Decomposition

ASTM D 1929 (1991a) Ignition Properties of Plastics

ASTM D 3841	(1997) Glass-Fiber-Reinforced Polyester Plastic Panels
ASTM E 72	(1998) Conducting Strength Tests of Panels for Building Construction
ASTM E 84	(1998el) Surface Burning Characteristics of Building Materials
ASTM E 108	(1996) Fire Tests of Roof Coverings
ASTM E 283	(1991) Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen
ASTM E 330	(1997) Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference
ASTM E 331	(1996) Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference

NATIONAL FENESTRATION RATING COUNCIL (NFRC)

NFRC 100	(1997) Procedure for Determining Fenestration Product U-factors
NFRC 200	(1997) Procedure for Determining Fenestration Product Solar Heat Gain Coefficients at Normal Incidence

1.2 GENERAL REQUIREMENTS

The Contractor shall furnish and install commercially available vaulted, metal framed, self supporting skylights which satisfy all requirements contained in this section and have been verified by load testing and independent design analyses (if required) to meet specified design requirements. The Contractor shall provide environmentally preferable products and work practices, applicable to skylights, considering raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, and/or disposal of the products or services used in the skylights. The skylight system shall be UV-stabilized, shatter proof and energy efficient. The plastics used in the manufacture of the skylights shall be light transmitting plastics for daylighting applications.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; G

Drawings showing fabrication details, materials, dimensions, installation methods, anchors, and relationship to adjacent construction.

SD-03 Product Data

Skylights; G

Manufacturer's descriptive data and catalog cuts.

Warranty; G.

Manufacturer's 5 year complete warranty.

SD-06 Test Reports

Test Reports; G.

Certified test reports from independent testing laboratory for each type and class of panel system. Reports shall verify that the material meets specified performance requirements. Previously completed test reports will be acceptable if they are current and indicative of products used on this project. Where a Class A, B or C roof is part of the project, a listing certificate for roof covering systems category shall be provided certifying that the product complies with the safety standards of ASTM E 108 and the Uniform Building Code.

SD-07 Certificates

Skylights; G

Manufacturer's certificate stating that products meet or exceed specified requirements. Skylight system shall be evaluated and listed (the whole skylight as a unit, not just a glazing material in the unit) by the recognized building code authorities: ICBO and SBCCI-Public Safety Testing and Evaluation Services Inc. Product ratings determined using NFRC 100 and NFRC 200 shall be authorized for certification and properly labeled by the manufacturer.

Qualifications; G.

Documentation of manufacturer's and installer experience indicating compliance with specified requirements.

1.4 QUALIFICATIONS

The manufacturer shall be a company specializing in the manufacture of the specified products with a minimum of 5 years documented experience. The installer shall have documented experience of 5 years minimum performing the work specified.

1.5 DELIVERY STORAGE AND HANDLING

System modules shall be factory assembled to the greatest extent possible. Panels shall be shipped to the jobsite in rugged shipping units and shall be ready for erection. All skylights shall have conspicuous decals affixed warning individuals against sitting or stepping on the units. Skylight panels shall be stored on the long edge, several mm (inches) above the ground, blocked and under cover to prevent warping. Unit skylights shall be delivered in manufacturer's original containers, dry, undamaged, with seals and labels intact. All products shall be delivered, stored and protected in accordance with manufacturer's recommendations.

1.6 WARRANTY

The Contractor shall provide to the Government the manufacturer's complete warranty for materials, workmanship, and installation. The warranty shall be for 5 years from the time of project completion and shall not be prorated. The warranty shall guarantee, but shall not be limited to, the following:

- a. Light transmission and color of the panels shall not change after exposure to heat of 149 degrees C (300 degrees F) for 25 minutes.
- b. There is no delamination of the panel affecting appearance, performance, weatherability or structural integrity of the panels or the completed system.
- c. There is no fiber bloom on the panel face.
- d. Change in light transmission of no more than 6% per ASTM D 1003, and in color (yellowing index) no more than 10 points in comparison to the original specified value over a 10 year period.

PART 2 PRODUCTS

2.1 SKYLIGHT PANELS

Skylight panels shall be fabricated of glass-fiber reinforced polyester or extruded cellular thermoplastic polycarbonate panels conforming to the specified requirements and other appropriate lab test specified criteria, weighing not less than 2.4 kg per square meter. (8 ounces per square foot.) Size and color of skylight panels shall be as indicated.

2.2 GLASS-FIBER PANELS

Glass-fiber reinforced polyester panels shall conform to ASTM D 3841, Class CC1, Grade 1 and to the requirements of AAMA/WDMA 1600/I.S.7.

2.2.1 Weatherability

The exposed faces of fiberglass sandwich type panels shall have a permanent glass veil erosion barrier embedded integrally to provide maximum long term resistance to reinforcing fiber exposure. The exterior face sheet shall be uniform in strength and be resistant to penetration by pencil point.

2.2.2 Non Combustible Grid Core

The aluminum I-beams shall be 6063-T6 with provisions for mechanical interlocking of muntin-mullion and perimeter to prevent high and low intersections which do not allow full bonding surface to contact with face material. Width of I-beam shall be no less than 11 mm (7/16 inch). I-beam grid shall be machined to tolerances of not greater than plus or minus 0.05 mm (0.002 inch) for flat panels. Panels shall withstand 650 degrees C (1200 degrees F) fire for a minimum of one hour without collapse or exterior flaming.

2.2.3 Adhesive

The laminate adhesive shall be heat and pressure resin-type engineered for structural sandwich panel use. Adhesive shall pass testing requirements specified by the International Conference of Building Officials' "Acceptance Criteria for Sandwich Panel Adhesive". Minimum strength shall be:

- a. Tensile Strength of 5.2 MPa (750 psi) in accordance with ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed in ASTM D 1037.
- b. Shear Strength, after exposure to five separate aging conditions in accordance with ASTM D 1002, shall be:
 - (1) 3.7 MPa (540 psi) at 50% relative humidity and 23 degrees C (73 degrees F).
 - (2) 5.5 MPa (800 psi) under accelerated aging per ASTM D 1037 at room temperature.
 - (3) 1.7 MPa (250 psi) under accelerated aging per ASTM D 1037 at 83 degrees C (182 degrees F).
 - (4) 9.7 MPa (1400 psi) after 500 hour Oxygen Bomb per ASTM D 572.
 - (5) 690 kPa (100 psi) at 83 degrees C (182 degrees F).

2.2.4 Panel Construction

Panels shall consist of fiberglass faces laminated to an aluminum I-beam grid core and shall deflect no more than 48 mm (1.9 inches) at 147 kg per square meter in 3 m (30 psf in 10 feet) per ASTM E 72, without a supporting frame. Quality control inspections and required testing, conducted at least once each year, shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with "Acceptance Criteria for Sandwich Panels" as regulated by the ICBO-ES or equivalent.

2.3 THERMOPLASTIC POLYCARBONATE PANELS

The system shall be manufactured from translucent polycarbonate panels designed for architectural applications. Panels shall consist of a polycarbonate resin with a permanent, co-extruded, ultra-violet protective layer; this layer shall be co-extruded by the manufacturer during the original extrusion of the panel and shall be a permanent part of the exterior and interior layers. Pot-applied coatings or films of dissimilar materials are unacceptable. Panel

width shall not exceed 600 mm (2 feet) to ensure best performance for wind uplift, vibration, oil canning and visual appearance. The following manufacturing requirements shall be met:

- a. Panel shall be extruded in one single formable length. Transverse sections are unacceptable. The panels shall be manufactured with upstands which are integral to the unit, and the upstands shall be 90 degrees to the panel face (standing seam dry glazed concept). Welding or gluing of upstands or standing seam is unacceptable.
- b. Mullions shall be dry glazed profiles, using no sealant, welding, adhesives or gaskets; mullions shall be thermally broken and continuous for panel length.
- c. For structural performance, the use of adhesives, plastic or sonic welding or sealant is not allowed.
- d. For longevity, the minimum ratio of panel weight to thickness shall be 4.4 kg/m^2 for 55, 75, and 100 mm double glazed (0.91 psf for 2.2, 3, and 4 inch double glazed) thick panel.
- e. The extruded panel shall include integral extruded multi-cells, and truss-like structural core for resistance to buckling. The panel's exterior skins shall be interconnected and spaced apart by supporting ribs, perpendicular to the skins, at a spacing not to exceed 4 mm (0.16 inches) (truss-like construction). In addition, the space between the two exterior skins in a cross section shall be divided by multiple parallel intermediate surfaces, at a spacing not to exceed 4 mm (0.16 inches).
- f. Interior flame spread classification shall be Class I in accordance with ASTM E 84.
- g. Smoke density shall be no greater than 70 in accordance with ASTM D 2843.
- h. The exterior and interior faces shall be an approved light transmitting panel with a CC1 fire rating classification in accordance with ASTM D 635.
- i. Self-ignition shall be greater than 570 degrees C (1058 degrees F) in accordance with ASTM D 1929.
- j. Fire rated roof assembly translucent panels shall be successfully evaluated for fire from exterior exposure per ASTM E 108 to meet Class A rating. The panel shall be listed by an independent recognized listing laboratory.

2.4 COMMON PANEL REQUIREMENTS

2.4.1 Appearance

The face sheets shall be uniform in color to prevent splotchy appearance. Faces shall be completely free of ridges and wrinkles which prevent proper surface contact. Clusters of air bubbles/pinholes which collect moisture and dirt are not acceptable.

2.4.2 Panel Fabrication

Panel construction shall meet the following requirements: Light transmission 50%; color “white” or “crystal”. Panel faces shall have a permanent erosion barrier either embedded beneath the surface or applied to the surface as a film or coating. Panel shall be subdivided with dark color grids forming a pattern of rectangular cells, nominal size 305 mm x 610 mm.

2.4.3 Thermal Performance

Thermal transmittance for skylights shall not exceed a U-factor of $2.6 \text{ W/m}^2 \text{ K}$ ($0.45 \text{ Btu/hr-ft}^2\text{-F}$) when determined using NFRC 100. Selection and use of the skylight products in this category shall be used in predominately heating dominated climates and be dependent upon qualifying for the Northern Climate Zone as determined by the DOE Energy Star Windows program.

2.4.4 Condensation Index Rating

The condensation index rating shall not be less than 70 as determined using National Fenestration Rating Council approved software THERM.

2.4.5 Integration Requirements

The manufacturer shall be responsible for the configuration, fabrication and integration of all panel components and the connections between panels, skylight framing and building framing systems. To the greatest extent practical the panels and frames shall be pre-assembled and sealed by the manufacturer.

2.4.6 Flammability

Panel faces shall not drip or otherwise discharge any material when exposed to flame.

2.5 SKYLIGHT SYSTEMS

The skylight systems shall meet the following requirements:

- a. Integral perimeter framing system assembly shall be by the manufacturer.
- b. Exterior panel faces shall be crystal in color. Interior panel faces shall be crystal in color.
- c. Air infiltration at 300 Pa (6.24 psf) shall be less than 0.5 L/s/m^2 (0.1 cfm/ft^2) in accordance with ASTM E 283.
- d. Water penetration at test pressure of 73 kg/m^2 (15 psf) shall be zero in accordance with ASTM E 331.
- e. Manufacturer shall be responsible for maximum system deflection, in accordance with the applicable building code, and without damage to system performance. Deflection shall be calculated in accordance with engineering principles.

- f. Proper weepage elements shall be incorporated within the perimeter framework of the glazing system for drainage of any condensation or water penetration.
- g. System shall accommodate movement within the system; movement between the system and perimeter framing components; dynamic loading and release of loads; and deflection of supporting members. This shall be achieved without damage to system or components, deterioration of weather seals and fenestration properties specified.
- h. The exterior panel face shall repel an impact of 81 N-m (60 foot-pounds) without fracture or tear when impacted by a 89 mm diameter, 2.9 kg (3.5 inch diameter, 6.37 pound) free falling ball. Impact strength shall be measured by the Society of Plastics Industries (SPI) method.
- i. Exposed aluminum color shall medium bronze selected from the manufacturer's standard range. Corrosion resistant finish shall be anodized finish complying with AA SAA-46, in accordance with AAMA 2605.
- j. The system shall require no scheduled recoating to maintain its performance or for UV resistance.
- k. Design criteria shall be: Wind Load (uplift) 185 Kg/square meter; snow load 135 Kg/square meter.
- l. Extruded aluminum shall be 6063-T6 and 6063-T5; all fasteners shall be stainless steel or cadmium plated steel.

2.5.1 Framed Skylights

Framing members shall be concealed I-beams; deflection of rafters (if required) shall not exceed L/175 of the rafter span. A registered professional engineer shall size all framing members and design all structural connections; the Contractor shall submit a copy of the calculations. Framing shall include a primary gutter system with secondary gutters to control water infiltration and condensation runoff from the underside of the glazing material and channel it to the exterior. Skylight structural members shall be designed for a live load of 135 Kg/square meter and wind load of 185 Kg/square meter; no objectionable distortion or stress in fastenings and joinery due to expansion and contraction shall be induced when subjected to a 55 degree C (100 degree F) temperature change.

2.6 FLEXIBLE SEALING TAPE

Sealing tape shall be manufacturer's standard pre-applied to closure system at the factory under controlled conditions.

2.7 FLASHING

All attachment, curb and counterflashing required to provide a complete and weathertight installation shall be provided by the skylight manufacturer. Material shall be aluminum with finish to match exposed framing components.

PART 3 EXECUTION

3.1 PREPARATION

The Contractor shall verify when structural support is ready to receive all specified work and to convene a pre-installation conference, if approved by the Contracting Officer, including the Contractor, skylight installer and all parties directly affecting and affected by the specified work. All submitted opening sizes, dimensions and tolerances shall be field verified; preparation of openings shall include isolating dissimilar materials from aluminum system to avoid damage by electrolysis. The installer shall examine area of installation to verify readiness of site conditions and to notify the Contractor about any defects requiring correction. Work shall not commence until conditions are satisfactory.

3.2 ERECTION

Translucent skylight system shall be erected in accordance with the approved shop drawings supplied by the manufacturer. Fastening and sealing shall be in accordance with the manufacturer's shop drawings. All panel protection shall be removed and, after other trades have completed work on adjacent materials, panel installation shall be carefully inspected and adjusted, if necessary, to ensure proper installation and weather-tight conditions. All staging, lifts and hoists required for the complete installation and field measuring shall be provided. System shall be installed clean of dirt, debris or staining and thoroughly examined for removal of all protective material prior to final inspection of the designated work area. Snow rakes shall not be used on roof windows/skylights.

END OF SECTION

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SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICANS WITH DISABILITIES ACT (ADA)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 283 (1991) Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen

ASTM F 883 (1990) Padlocks

BUILDERS HARDWARE MANUFACTURERS ASSOCIATION, INC. (BHMA)

ANSI/BHMA A156.1 (1997) Butts and Hinges (BHMA 101)

ANSI/BHMA A156.2 (1996) Bored and Preassembled Locks and Latches (BHMA 601)

ANSI/BHMA A156.3 (1994) Exit Devices (BHMA 701)

ANSI/BHMA A156.4 (1992) Door Controls - Closers (BHMA 301)

ANSI/BHMA A156.5 (1992) Auxiliary Locks & Associated Products (BHMA 501)

ANSI/BHMA A156.6 (1994) Architectural Door Trim (BHMA 1001)

ANSI/BHMA A156.7 (1988) Template Hinge Dimensions

ANSI/BHMA A156.8 (1994) Door Controls - Overhead Holders (BHMA 311)

ANSI/BHMA A156.12 (1992) Interconnected Locks & Latches (BHMA 611)

ANSI/BHMA A156.13 (1994) Mortise Locks & Latches (BHMA 621)

ANSI/BHMA A156.15 (1995) Closer Holder Release Devices

ANSI/BHMA A156.16 (1997) Auxiliary Hardware

ANSI/BHMA A156.17 (1993) Self Closing Hinges & Pivots

ANSI/BHMA A156.18 (1993) Materials and Finishes (BHMA 1301)

ANSI/BHMA A156.21 (1996) Thresholds

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 101 (2000) Life Safety Code

STEEL DOOR INSTITUTE (SDI)

ANSI/SDI 100 (1991) Standard Steel Doors and Frames

UNDERWRITERS LABORATORIES INC. (UL)

UL BMD (1999) Building Materials Directory

UL 14C (1999) Swinging Hardware for Standard Tin-Clad Fire
Doors Mounted Singly and in Pairs

UNIFORM FEDERAL ACCESSIBILITY STANDARDS (UFAS)

1.2 SUBMITTALS

Submit the following in accordance with SECTION: "Submittal Procedures."

SD-01 Personnel Certification

Name of and documentation for bonded, licensed locksmith for final keying and
combinating; G

SD-02 Shop Drawings

Hardware schedule; G

Keying system/schedule; G

SD-03 Product Data

Hardware items; G

SD-08 Manufacturer's Instructions

Installation

SD-10 Operation and Maintenance Data

Hardware Schedule items, Data Package 1

Submit data package in accordance with SECTION: "Operation and Maintenance Data."

SD-11 Closeout Submittals

Key biting

1.3 HARDWARE SCHEDULE

Prepare and submit hardware schedule in the following form:

Hard- ware Item	Quan- tity	Size	Reference		Mfr. Name and Catalog No.	Key Con- trol Symbols	UL Mark (If fire rated and listed)	ANSI/BHMA Finish Designa- tion
			Type	Finish				
-----	-----	-----	-----	-----	-----	-----	-----	-----

1.4 KEY BITTING CHART REQUIREMENTS

Submit the original key biting charts in a sealed envelope to the Contracting Officer prior to completion of the work. Envelope shall include the name of the project and be addressed to: "Fort Lewis Public Works Lock Shop Manager". Include:

- Complete listing of all keys (AA1, AA2, etc.).
- Complete listing of all key cuts (AA1-123456, AA2-123456).
- Tabulation showing which key fits which door.
- Copy of floor plan showing doors and door numbers.
- Listing of 20 percent more key cuts than are presently required in each master system.

1.5 QUALITY ASSURANCE

1.5.1 Hardware Manufacturers and Modifications

Provide, as far as feasible, locks, hinges, pivots, and closers of one lock, hinge, pivot, or closer manufacturer's make. For example, Stanley Architectural Hardware, Ingersoll-Rand Architectural Hardware, and ASSA-ABLOY Architectural Hardware can provide full product lines for hardware. Modify hardware as necessary to provide features indicated or specified.

Accessibility

At indicated openings hardware shall meet or exceed the requirements of the Americans with Disabilities Act (ADA) and the Uniform Federal Accessibility Standards (UFAS).

1.5.2 Aluminum Doors and Storefronts

All hardware mounted on aluminum doors and storefront systems shall be coordinated and supplied by the door manufacturer. Hardware for aluminum doors shall be indicated in this section. Deliver Hardware templates and hardware, except field-applied hardware to the aluminum door and frame manufacturer for use in fabricating the doors and frames.

1.6 DELIVERY, STORAGE, AND HANDLING

Deliver hardware in manufacturer's original individual containers, complete with necessary appurtenances including fasteners and instructions. Mark each individual container with item number as shown in hardware schedule. Where double cylinder functions are used or where it is not obvious which is the key side of a door, appropriate instructions shall be included with the lock and on the hardware schedule.

1.7 CONTROL OF LOCK CORES AND KEYING

The contractor shall provide all hardware and construction (temporary) cores required to secure buildings, utility access and related work throughout the construction period. Construction cores shall have a bright color on their exposed face for ease of identification. During construction the contractor shall meet with representatives of the contracting officer, Public Works Lock Shop and the user to develop a keying schedule. This schedule shall be submitted for approval in accordance with Article: Submittals. The contractor shall provide final lock cores, complete, pinned and combined, with cut keys as specified. All final keying and combining shall be performed by a licensed, bonded locksmith approved by the contracting officer. Upon acceptance of the facility for occupancy, the contractor shall replace construction cores with final cores in the presence of the government inspector and a Public Works locksmith, test each lock for proper operation and deliver any permanent or control keys to the inspector. Prior to core change out the contractor shall provide the government, by security shipment, with keys tagged with identifying labels in the quantities indicated.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of installed door hardware with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Control of keys and permanent lock cores as specified.
- (2) Protection of all materials during on site storage.
- (3) Verification that all hardware coordination related to accessibility and fire rated construction requirements is performed.

- (4) Verification of compliance of materials with specification before, during and after installation.
- (5) Coordination of keying schedule meeting with Public Works Locksmith.
- (6) Verification of proper hardware function on all openings.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 TEMPLATE HARDWARE

Hardware to be applied to metal shall be made to template. Promptly furnish template information or templates to door and frame manufacturers. Template hinges shall conform to ANSI/BHMA A156.7. Coordinate hardware items to prevent interference with other hardware.

2.2 HARDWARE FOR FIRE DOORS AND EXIT DOORS

Provide all hardware necessary to meet the requirements of NFPA 80 for fire doors and NFPA 101 for exit doors, as well as to other requirements specified, even if such hardware is not specifically mentioned under paragraph entitled "Hardware Schedule." Such hardware shall bear the label of Underwriters Laboratories, Inc., and be listed in UL BMD or labeled and listed by another testing laboratory acceptable to the Contracting Officer.

2.3 HARDWARE ITEMS

Hinges, pivots, locks, latches, exit devices, bolts, and closers shall be clearly and permanently marked with the manufacturer's name or trademark where it will be visible after the item is installed. For closers with covers, the name or trademark may be beneath the cover.

2.3.1 Hinges

Hinges (butts) shall be full mortise type, conform to ANSI/BHMA A156.1, size 114 mm by 114 mm, except where specified otherwise. Design of hinge shall not restrict full opening arc of door swing. All doors equipped with closers, and as otherwise specified, shall use a ball bearing hinge. Hinges on exterior doors shall be stainless steel. Construct loose pin hinges for exterior doors and reverse-bevel interior doors so that pins will be non-removable (NRP) when door is closed. All exterior doors and doors on stair enclosures shall be equipped with a continuous hinge.

2.3.2 Pivots

ANSI/BHMA A156.4.

2.3.3 Locks and Latches

To the maximum extent possible, locksets, latchsets and deadlocks shall be the products of a single manufacturer. Unless otherwise specified, all locks and latches shall be provided complete with manufacturer's standard strike. Strikes for wood frames and pairs of wood doors shall be furnished with wrought boxes. Strikes for metal frames shall have manufacturer's standard boxes. Lock and latch trim (levers, handles, roses and escutcheons) shall be of simple design in accordance with manufacturer's standard practice. Levers shall have a minimum length of 110-mm.

2.3.3.1 Mortise Locks and Latches

ANSI/BHMA A156.13, Series 1000, Operational Grade 1, Security Grade 2. Provide mortise locks with escutcheons not less than 178 by 57 mm with a bushing at least 6 mm long. Cut escutcheons to suit cylinders and provide trim items with straight, beveled, or smoothly rounded sides, corners, and edges. Strikes for all mortise locks and latches (including deadlocks) shall conform to DHI 115.1 (except strikes for security doors shall be rectangular without lip). Mortise locks shall have armored fronts. Knobs and roses of mortise locks shall have screwless shanks and no exposed screws.

2.3.3.2 Bored Locks and Latches

ANSI/BHMA A156.2, Series 4000, Grade 1. Strikes for bored locks and latches shall conform to DHI 115.2. Bored locks and latches for doors 35 mm thick and over, shall have adjustable bevel fronts or otherwise conform to the shape of the door.

2.3.3.3 Auxiliary Locks

Bored and mortise deadlocks and latchsets, narrow stile locks, rim locks, electric strikes, monitor strikes, and exit alarms and/or locks shall conform to ANSI/BHMA A156.5, Grade 1. Strike boxes shall be furnished with dead bolt and latch strikes for Grade 1.

2.3.3.4 Mechanical Combination Locks

Heavy-duty, mechanical combination lockset with five pushbuttons, conforming to ANSI 156.2, Grade 1, standard-sized knobs, 16 mm deadlocking latch, 70 mm backset. Lock shall be operated by pressing two or more of the buttons in unison or individually in the proper sequence. Inside knob shall always operate the latch. Provide a keyed cylinder on the interior to permit setting the combination. Provide a keyed, A-2 Small Format Interchangeable Core (SFIC) compatible, 7-pin interchangeable cylinder core on all exterior doors to permit key bypass.

Example product: Unican 1021B Series, by ILCO Unican Corp.

2.3.3.5 Programmable Pushbutton Locks

Electronic (stand alone battery power) cylindrical lockset with clutch mechanism shall comply with ANSI/BHMA 156.2, Grade 1 (extra heavy duty). Latchbolt shall be 18 mm throw with 70 mm backset. Latchbolt shall engage manufacturer's standard strike plate and matching strike box. Lock shall be powered by internal batteries providing 4 years of operation. All lock operation code entry and programming shall be performed using a 12 button keypad. Front

housing shall also provide red and green indicator lights and an acoustic device to signal lock status to the user. Lever handles shall comply with Americans with Disabilities Act (ADA). Design of lever shall be of single piece construction without any return at the end. Outside lever shall be connected to a heavy duty clutch mechanism that will permit turning the lever without retracting the latch in the locked position. Inside and outside levers shall operate independent of each other. Inside lever provides free egress at all times. Unlocking angle of rotation should not exceed 45 degrees. Outside lever shall accommodate an A-2 SFIC. Core shall allow mechanical override key operation of the lockset. Programmable pushbutton feature shall provide ability to easily change code combinations. Multiple entry codes (4 minimum) and authorization levels shall be provided. User entry code shall be adjustable from 3 to 6 digits. Memory of lock shall be non-volatile and shall retain codes for at least 1 year without battery power and while batteries are being changed. Lock shall include a tamper resistance shut down feature to limit guessing of access codes. Shut down will be maintained for up to 15 minutes.

Example product: Unican 4000 Series, by ILCO Unican Corp.

2.3.4 Exit Devices

Conform to ANSI/BHMA A156.3, Grade 1. Exit devices shall be rim or mortise type, vertical rod devices are not acceptable. Provide adjustable strikes for rim type. Provide open back strikes for pairs of doors with mortise. Touch bars shall be provided in lieu of conventional crossbars and arms. Exit devices at full glazed doors shall have a continuous cover plate on the back side of the horizontal member to provide a clean, finished appearance when viewed through glazing, finish shall match the exit device. Exit devices shall have a mechanical dogging feature.

2.3.5 Cylinders and Cores

Provide cylinders and cores for new locks, including locks provided under other sections of this specification. Cylinders and cores shall have seven pin tumblers. Cylinders shall be products of one manufacturer, and cores shall be the products of one manufacturer. Rim cylinders, mortise cylinders, and levers of bored locksets shall have interchangeable cores which are compatible with A-2 SFIC and are removable by special control keys. Stamp each interchangeable core with a key control symbol in a concealed place on the core.

2.3.6 Keying System

Provide a great grand master keying system as coordinated in keying schedule meeting with government. Provide a construction master keying system consistent with use of construction interchangeable cores. Provide key cabinet as specified.

2.3.7 Lock Trim

Cast, forged, or heavy wrought construction and commercial plain design.

2.3.7.1 Knobs and Roses

In addition to meeting test requirements of ANSI/BHMA A156.2 and ANSI/BHMA A156.13, knobs, roses, and escutcheons shall be 1.25 mm thick if unreinforced. If reinforced, outer shell shall be 0.89 mm thick and combined thickness shall be 1.78 mm, except knob shanks

shall be 1.52 mm thick. Knobs shall be used only where indicated. Lever handles are standard. Knob design shall be similar to Schlage "Orbit" or Best "No. 4" – rose "C".

2.3.7.2 Lever Handles

Provide lever handles as standard.. Lever handles for exit devices shall meet the test requirements of ANSI/BHMA A156.13 for mortise locks. Lever handle locks shall have a breakaway feature (such as a weakened spindle or a shear key) to prevent irreparable damage to the lock when a force in excess of that specified in ANSI/BHMA A156.13 is applied to the lever handle. Lever handles shall return to within 13 mm 1/2 inch of the door face. Lever design shall be similar to Schlage "Sparta" or Best No. 14.

2.3.7.3 Texture

Provide knurled or abrasive coated knobs or lever handles where specified in paragraph entitled "Hardware Schedule".

2.3.8 Keys

Furnish one file key, one duplicate key, and one working key for each master and grand master keying system. Furnish four (4) change keys per lock core, 6 master keys, and 6 control keys to the Public Works Lock Shop for control and issuing. Furnish two additional keys for each living/sleeping room. Furnish a quantity of key blanks equal to 20 percent of the total number of file keys. Stamp each key with appropriate key control symbol and "U.S. property - Do not duplicate." Key bows must be stamped with key code line ID (example: LA1223, MPA1223, etc.). All Fort Lewis codes are 1 to 4 letters and 1 to 4 numbers. Public Works Lock Shop will provide ID information and Master control number to be used in combining core. Do not place room number on keys.

2.3.9 Door Bolts

ANSI/BHMA A156.16. Provide dustproof strikes for bottom bolts, except for doors having metal thresholds. Automatic latching flush bolts: ANSI/BHMA A156.3, Type 25.

2.3.10 Closers

ANSI/BHMA A156.4, Series C02000, Grade 1, with PT 4C and PT-4D. All closers (except those mounted on fire rated doors) shall be provided with built in hold open and dead stop functions. Closers located in the BTN HQ and SCB buildings shall have speed adjusted to meet ADA requirements. Closers on doors swinging against a wall at 90 degrees shall be provided with PT-4E adjustable hydraulic backcheck. Provide closers with brackets, arms, mounting devices, fasteners, full size covers (except at storefront mounting), pivots, cement cases, and other features necessary for the particular application and functional requirements. Provide multi-size closers PT-4H Sizes 2 through 6, (except at accessible (ADA) locations 1 through 4) and list sizes in the Hardware Schedule. Closers for outswinging exterior doors shall have parallel arms or shall be top jamb mounted as indicated in hardware sets. Closers for doors close to a wall shall be of narrow projection so as not to strike the wall at the 90-degree open position. Provide manufacturer's 10 year warranty.

2.3.10.1 Identification Marking

Engrave each closer with manufacturer's name or trademark, date of manufacture, and manufacturer's size designation located to be visible after installation.

2.3.11 Overhead Holders

ANSI/BHMA A156.8.

2.3.12 Door Protection Plates

Conform to ANSI/BHMA A156.6.

2.3.12.1 Sizes of Armor, Mop and Kick Plates

Width for single doors shall be 50 mm less than door width; width for pairs of doors shall be 25 mm less than door width. Height of kick plates shall be 250 mm for flush doors and 25 mm less than height of bottom rail for panel doors. Height of armor plates shall be 1200mm for flush doors and shall completely cover lower panels of panel doors, except that armor plates on fire doors shall be 400 mm high. Height of mop plates shall be 100.

2.3.13 Door Stops and Silencers

ANSI/BHMA A156.16. Silencers Type L03011. Provide three silencers for each single door, two for each pair. Coordinate with SECTION: STEEL DOORS AND FRAMES.

2.3.14 Padlocks

Conform with ASTM F 883. Incorporate keying compatible with that specified for other locks.

2.3.15 Padlock Eyes (Room Module Closet)

Padlock eyes shall be steel, 2 mm nominal thickness, with plated finish. Eyes shall be sized for attachment to door and frame with 4 sheet metal screws each. Locate eyes 300 mm above latchset with one eye attached to door edge and second eye attached to immediately opposing frame surface such that eyes align side by side when door is closed and all screws are concealed. Maximum projection from door face to tip of eyes shall be 30 mm. Eye hole diameter and projection from door shall permit the use of standard combination or key type padlocks. Coordinate frame fabrication to provide for recess mounting of eye plate. Coordinate required door gap to accommodate eye thickness without restricting door swing.

2.3.16 Thresholds

Conform with ANSI/BHMA A156.21. Thresholds for exterior doors shall be extruded aluminum of the type as indicated and shall provide proper clearance for door swing and effective seal with specified weather stripping. Thresholds for use with floor closers shall conform to BHMA A156.4. Where required, thresholds shall be modified to receive projecting bolts of exit devices.

2.3.17 Weather Stripping

A set shall include head and jamb seals, sweep strips, and, for pairs of doors, astragals. Air leakage of weather stripped doors shall not exceed 5.48×10^{-5} cms per minute of air per square meter of door area when tested in accordance with ASTM E 283. Weather stripping shall be extruded aluminum retainers not less than 1.25 mm wall thickness with vinyl, neoprene, silicone rubber, or polyurethane inserts. Aluminum shall be clear anodized.

2.3.18 Soundproofing

A set shall include adjustable doorstops at head and jambs and an automatic door bottom, both of extruded aluminum, clear anodized, surface applied, with vinyl fin seals between plunger and housing. Doorstops shall have solid neoprene tube, silicone rubber, or closed-cell sponge gasket. Door bottoms shall have adjustable operating rod and silicone rubber or closed-cell sponge neoprene gasket. Doorstops shall be mitered at corners. Zero "Sound Stop 1" (No. 770 and No. 361); Pemko No. 350ASN and No. 430AS; National Guard No. 1038N and No. 420; or equal.

2.3.19 Rain Drips

Extruded aluminum, not less than 2.03 mm thick, clear anodized. Set drips in sealant conforming to SECTION, "JOINT SEALING," and fasten with stainless steel screws. Approximately 38 mm high by 25 mm projection, with length equal to overall width of door frame. Align bottom with door frame rabbet.

2.3.20 Astragals

Provide astragals at barracks Mechanical Closet (off entrance corridors) door pairs that meet U.L. and NFPA requirements for fire rated doors. Astragals shall be Pemko 355SP or equal. Paint astragals to match door surface.

2.3.21 Special Tools

Provide special tools, such as spanner and socket wrenches and dogging keys, required to service and adjust hardware items.

2.4 FASTENERS

Provide fasteners of proper type, quality, size, quantity, and finish with hardware. Fasteners exposed to weather shall be of nonferrous metal or stainless steel. Provide fasteners of type necessary to accomplish a permanent installation.

2.5 FINISHES

ANSI/BHMA A156.18. Hardware shall have BHMA 630 finish (satin stainless steel), unless specified otherwise. Provide items not manufactured in stainless steel in BHMA 626 finish satin chromium plated over brass or bronze, except surface door closers which shall have aluminum paint finish, and except steel hinges which shall have BHMA 600 finish (primed for painting). Hinges for exterior doors shall be stainless steel with BHMA 630 finish or chromium plated brass or bronze with BHMA 626 finish. Exit devices may be provided in BHMA 626 finish in lieu of BHMA 630 finish except where BHMA 630 is specified under

paragraph entitled "Hardware Sets". Exposed parts of concealed closers shall have finish to match lock and door trim. Hardware for aluminum doors shall be finished to match the doors.

2.6 KEY CABINET AND CONTROL SYSTEM

Conform to ANSI/BHMA A156.5, Provide E8341 (125 hooks) at Company Operations and Battalion Headquarters buildings. Provide E8311 (600 hooks) at Soldier Community Building.

PART 3 EXECUTION

3.1 INSTALLATION

Install hardware in accordance with manufacturers' printed instructions. Locations shall generally conform with DHI-04 and DHI-05. When approved, slight variations in locations or dimensions will be permitted. Fasten hardware to wood surfaces with full-threaded wood screws or sheet metal screws. Provide machine screws set in expansion shields for fastening hardware to solid concrete and masonry surfaces. Provide toggle bolts where required for fastening to hollow core construction. Door control devices for exterior doors such as closers and holders, shall normally attach to doors with through bolts such as sex bolts and nuts. Through bolts shall be finished to match the door. Through bolting of aluminum doors is not acceptable.

3.1.1 Weather Stripping Installation

Handle and install weather stripping so as to prevent damage. Provide full contact, weather-tight seals. Doors shall operate without binding.

3.1.1.1 Stop-Applied Weather Stripping

Fasten in place with color-matched sheet metal screws not more than 225 mm on center after doors and frames have been finish painted.

3.1.2 Soundproofing Installation

Install as specified for stop-applied weather stripping.

3.1.3 Threshold Installation

Extend thresholds the full width of the opening and notch end for jamb stops. Set thresholds in a full bed of sealant and anchor to floor with cadmium-plated, countersunk, steel screws in expansion sleeves.

3.1.4 Door-Closing Devices

Door closing devices shall be installed and adjusted in accordance with the templates and printed instructions supplied by the manufacturer of the devices. Insofar as practicable, doors opening to or from halls and corridors shall have the closer mounted on the room side of the door. Closer locations shall be coordinated with the door manufacturer to ensure proper reinforcement of the door.

3.1.5 Kick Plates and Mop Plates

Kick and armor plates shall be installed on the push side of single-acting doors and on both sides of double-acting doors. Mop plates shall be installed on the pull side of single acting doors with bottom flush with door bottom.

3.2 FIRE DOORS AND EXIT DOORS

Install hardware in accordance with NFPA 80 for fire doors, and NFPA 101 for exit doors. Exit devices installed on fire doors shall have a visible label bearing the marking "Fire Exit Hardware". Other hardware installed on fire doors, such as locksets, closers and hinges shall have a visible label or stamp indicating that the hardware items have been approved by "an approved testing agency for installation on fire-rated doors". Hardware for smoke-control door assemblies shall be installed in accordance with NFPA 105.

3.3 KEY CABINET AND CONTROL SYSTEM

Locate where directed by Contracting Officer. Tag one set of file keys and one set of duplicate keys. Place other keys in appropriately marked envelopes, or tag each key. Furnish complete instructions for setup and use of key control system. On tags and envelopes, indicate door and room numbers or master or grand master key.

3.4 FIELD QUALITY CONTROL

After installation, protect hardware from paint, stains, blemishes, and other damage until acceptance of work. Submit notice of testing 15 days before scheduled, so that testing can be witnessed by the Contracting Officer. Adjust hinges, locks, latches, bolts, holders, closers, and other items to operate properly. Demonstrate that permanent keys operate respective locks, and give keys to the Contracting Officer. Correct, repair, and finish, as directed, errors in cutting and fitting and damage to adjoining work.

3.5 BARRACKS AND SCB HARDWARE SETS (HW)

Where possible, all door hardware components are listed with ANSI/BHMA standard numbering and nomenclature for Door Hardware. Indication of specific manufacturer's products is made for purposes of clarification of intent only. Use of other manufacturer's products conforming to the characteristics of the product indicated is acceptable.

HW-1

Doors: (S01) Room Module Entrance from Corridor (60 min. rated)

Hinges: (1-1/2 pair) A8111 (626)

Lockset: Programmable Pushbutton – ILCO Unican 4000 Series (626), with
Levers

Closer: C02011 (626) w/ option PT 4C

Threshold: J36130 (673) (Pemko 2005AS)

Door Stop: L02101 (626) wall type

Gasketing: S88BL (Pemko)

HW-2

Doors: (S02, S04) Living/Sleeping Room Door
Hinges: (1-1/2 pair) A8111 (626)
Lockset: F 84 Grade 1 (626) – Levers (Classroom)
Door Stop: L02101 (626) wall type
Gasketing: S88D (Pemko)

HW-3

Doors: (S03, S05) Room Module Closet
Hinges: (1-1/2 pair) A8132 (626)
Latchset: F- 75 Grade 1 (626) – Levers (Passage)
Padlock Eyes: (2) (626)
Silencers: L03011

HW-4

Doors: (S06) Room Module Bathroom
Hinges: (1-1/2 pair) A8111 (626)
Lockset: F 76 Grade 1 (626) – Levers (Bath)
Door Stop: L02101 (626) wall type
Robe Hook: L03111 (626)
Silencers: L03011

HW-5

Doors: (S07) Mechanical (Utility) Closet from Corridor (60 min. rated)
Hinges: (1-1/2 pair) A8112 (626)
Lockset: F 86 Grade 2 (626) – Levers (Store Rm.)
Closer: C02021 (626) w/ option PT 4C
Gasketing: S88BL (Pemko)
Astragal: 355 CS (Pemko)

HW-6

Doors: (S08) Single Door Mech. (Utility) Closet and Comm. Room from Corridor (60 min. rated)
Hinges: (1-1/2 pair) A8112 (626)
Lockset: F 86 Grade 2 (626) – Levers (Store Rm.)
Closer: C02011 (626) w/ option PT 4C
C02021 (626) w/ option PT 4C at Utility Closet
Door Stop: L02101 (626) wall type
Gasketing: S88BL (Pemko)

HW-7

Doors: Mechanical Room from Exterior (Door Pair) (60 min. rated at Barracks only)

SCB: Mechanical and Storage from Exterior (Door Pairs)

Hinges: (2) Continuous Geared Hinge (Pemko CFM)
Lockset: (2) F 84 Grade 1 (626) – Levers (Classroom)
Door Holder: (2) C 00511 (626) – Frame Stop Mount
Kickplate: (2) J 102 w/ B3E (626) (size: width less 50 x 300)
Threshold: J32130 (627)
Door Bottom: (2) (Pemko 210 AV)
Removable Mullion: Key release type , Match door frame finish. See door sched.
Weatherstripping: (Pemko 296 CR) Jambs and Head
Rain Drip: Continuous (627)

HW-8

Doors: Electrical Room from Exterior (60 min. rated at Barracks only)

SCB: Electrical Room and Mud Room

Hinges: Continuous Geared Hinge (Pemko CFM)
Lockset: F 84 Grade 1 (626) – Levers (Classroom)
Door Holder: C 00511 (626) – Frame Stop Mount
Kickplate: J 102 w/ B3E (626) (size: width less 50 x 300)
Threshold: J32130 (627)
Door Bottom: (Pemko 210 AV)
Door Stop: L02131 Surface type
Weatherstripping: (Pemko 296 CR) Jambs and Head
Rain Drip: Continuous (627)

HW-9

Doors: Barrack Stair from Corridor

Hinges: (1-1/2 pair) A8111
Exit Device: Grade 1, Type 1, F-08 Lever, no lock.
Closer: C02011 (626) w/ option PT 4C
Kickplate: J 102 w/ B3E (626) (size: width less 50 x 300)
Door Stop: L02101 (626) wall type
Gasketing: S88BL (Pemko)

HW-10

Doors: Barrack Entrance from Exterior

Hinges: Continuous Geared Hinge (Pemko CFM)
Exit Device: Grade 1, Type 1, F-04
Lock cylinder: Match cylinders in bored locksets
Trim: J 402 Door Pull (626) (offset)
250 center to center – thru bolt.
Closer: C02061 (626) w/ option PT 4C and 4D
Kickplate: J 102 w/ B3E (626) (size: width less 50 x 300)
Threshold: J32130 (627)
Door Stop: L02131 Surface type
Door Bottom: (Pemko 210 AV)
Weatherstripping: (Pemko 296 CR) Jambs and Head
Rain Drip: Continuous (627)

HW-11

Doors: SCB - Entrance from Exterior

Hinges: (2) Continuous Geared Hinge (Pemko CFM)

Exit Device: (2) Grade 1, Type 1, F-04

Lock cylinder: (2) Match cylinders in bored locksets

Trim: (2) J 402 Door Pull (626) (offset)
250 center to center – thru bolt.

Closer: (2) C02061 (626) w/ option PT 4C and 4D

Kickplate: (2) J 102 w/ B3E (626) (size: width less 50 x 300)

Threshold: J32130 (627)

Door Stop: (2) L02131 Surface type

Door Bottom: (Pemko 210 AV)

Removable Mullion: Key release type , Match door frame finish, see door sched.

Weatherstripping: (Pemko 296 CR) Jambs and Head

HW-12

Doors: SCB – CQ Office from Corridor (20 min. rated)

Hinges: (1-1/2 pair) A8111

Lockset: F 84 Grade 1 (626) Levers (Classroom)

Closer: C02011 w/ option PT 4C

Mop plate: J103 (w/ B3E) (626) (size w-50 x 150)

Door Stop: L02141 (626) floor type

Gasketing: S88BL (Pemko)

HW-13

Doors: SCB – CQ Supplies and Janitor Supplies from CQ Office (20 min. rated)

Hinges: (1-1/2 pair) A8111

Lockset: F 86 Grade 1 (626) Levers (Store Rm.)

Closer: C02051 w/ option PT 4C

Mop plate: J103 (w/ B3E) (626) (size w-50 x 150)

Door Stop: L02101 (626) wall type

Gasketing: S88BL (Pemko)

HW-14

Doors: SCB – Laundry, Janitor Closet and Communications from Corridor (20 min. rated)

Hinges: (1-1/2 pair) A8111

Lockset: F 84 Grade 1 (626) Levers (Classroom)

Closer: C02021 w/ option PT 4C

Door Stop: L02101 (626) wall type

L02141 (626) floor type at Laundry

Gasketing: S88BL (Pemko)

HW-15

Doors: SCB – Dryer Chase Access (20 min. rated)

Hinges: (1-1/2 pair) A8112

Lockset: F 86 Grade 1 (626)

Closer: C02051 w/ option PT 4C

Door Stop: L02101 (626) wall type

Gasketing: S88BL (Pemko)

HW-16

Doors: SCB – Mail Office from Corridor (20 min. rated)
Hinges: (1-1/2 pair) A8111
Lockset: F 84 Grade 1 (626) Levers (Classroom)
Deadbolt: E0171 (626)
Closer: C02011 w/ option PT 4C
Gasketing: S88BL (Pemko)

HW-17

Doors: SCB – Toilet Rooms from Corridor (20 min. rated)
Hinges: (1-1/2 pair) A8111
Lockset: F 76 Grade 1 (626)
Closer: C02011 w/ option PT 4C
Mop plate: J103 (w/ B3E) (626) (size w-50 x 150)
Door Stop: L02101 (626) wall type
Gasketing: S88BL (Pemko)

3.6 MEDIUM COMPANY OPERATIONS FACILITY HARDWARE SETS (COHW)

EXTERIOR DOOR HARDWARE

COHW-1

Main Entry door, second floor exit doors

Hinges: (1 ½ pair) A5111
Exit device: 5-08 Stainless Steel Lever Handles
Flush bolt: Dust proof strike with exit device, strike compatible 104021
Closer: C02061
Kickplate: J106(black) 300mm high
Threshold: 257A Pemko
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko
Door Stop L52121

COHW-2

Exterior locker/shower doors

Hinges: (1 ½ pair) A5111
Latchset: F08 with stainless steel Lever Handles
Closer: C02061 with option PT4C
Kickplate: J106(black) 300mm high
Threshold: 257A Pemko
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko

COHW-3

Exterior doors @ unit storage & electrical room

Hinges: (1 ½ pair) A5111
Latchset: F04 with stainless steel Lever Handles
Closer: C02061 with option PT4C
Kickplate: J106(black) 300mm high
Threshold: 257A Pemko
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko

COHW-4

Exterior pair of doors @ equip maintenance

Hinges: (3 pair) A5111
Exit device: 5-08 with stainless steel Lever Handles w/self latching bolts
Flush Bolt: Dust proof Strike with exit device, strike compatible 104021
Closer: C02061 PT4C
Kickplate: J106(black) 12" high
Threshold: 257A Pemko
Door stop/hold: L01371
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko
Meeting Stile: 351C Pemko

COHW-5

Exterior pair of doors @ mechanical room

Hinges: (3 pair) A5111
Latchset: F04 with stainless steel Lever Handles
Flushbolts: L14081 inactive leaf
Astragal: 357A Pemko
Dust proof strike: 104021
Door holders: 101381
Threshold: 257A Pemko
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko

COHW-6

Exterior door @ storage by arms room

Hinges: (1 ½ pair) A5111
Latchset: F04 with stainless steel Lever Handles
Door holders: L01381
Closer: C02061 with option PT4C
Threshold: 257A Pemko
Gasketing: S88D Pemko
Bottom: 315AN Pemko
O.H. Dripcaps: 346C Pemko

COHW-7

Not Used

INTERIOR DOORS

COHW-8

Hall Bathroom Doors(Disabled Access, 45 minute door system)

Hinges: (1 ½ pair) A5111
Latchset: F19 with stainless steel Lever Handles
Closer: C02021 with option PT4C
Gasketing: S88D Pemko
Kickplate: J106 (black)
Door Bumper: L32261 with Finish 627

COHW-9

Janitor Doors/Telcom RM/AHU Room/Elec. (45 minute door system)

Hinges: (1 ½ pair) A5111
Latchset: F04 with stainless steel Lever Handles
Closer: C02021 with option PT4C
Gasketing: S88D Pemko
Door Bumper: L32261 with Finish 627

COHW-10

Door from Eq Maintenance to Corridor(45 minute door system)

Hinges: (1 ½ pair) A5111
Latchset: F14 with stainless steel Lever Handles
Closer: C02021 with option PT4C
Gasketing: S88D Pemko
Kickplate: J106 (black)
Door Bumper: L32261 with Finish 627
Provide sign: "Door to remain unlocked when occupied"

COHW-11

Hardware by Metal Partition Door Supplier

Expanded Metal 2 Leaf Door (Dutch Door)

Hinges: (3 pair) A5111
Latchset: F17
Surface bolt: L04131 mortise into shelf
Latchset: F14 with stainless steel Lever Handles
Silencers: L03011

NOTE: Door hardware mentioned is only to communicate general hardware information to door supplier. Supplier to provide hardware that is fully compatible within door system.

COHW-12

Hardware by Metal Partition Door Supplier
Pair Expanded Metal 2 Leaf Door (Dutch Door)

Hinges: (4 pair) A5111
Latchset: F17
Latchset: F14 with stainless steel Lever Handles
Floor/Top Bolt: L04161 provide dustproof strike
Surface bolt: L04131 mortise into shelf
Silencers: L03011
Door holders: 2 each

NOTE: Door hardware mentioned is only to communicate general hardware intent to door supplier. Supplier to provide hardware that is fully compatible within door system.

COHW-13

Vault door with day gate
Hardware by Vault Door Supplier

Note: Coordinate keying with this section

COHW-14

Demising Shower Room Door/Partition

Hinges: (1-1/2 pair) A5111
Deadbolt: F16 with stainless steel lever Handles
Gasketing: S88D Pemko
Bottom: 321AN

NOTE: Secure door bottom tightly to the floor. Door is not intended to operate. Ensure complete overlap.

COHW-15

Corridor Doors/Admin/Platoon/Conf. (45 Minute Door System)

Hinges: (1-1/2 pair) A5111
Latchset: F04 with stainless steel Lever Handles
Closer: C02021 with option PT4C
Gasketing: S88D Pemko
Door Bumper: L32261Pemko

COHW-16

Office Doors

Hinges: (1-1/2 pair) A5111
Latchset: F04 with stainless steel Lever Handles
Closer: C02061 with option PT4C
Silencers: L03011

COHW-17

Pair of Closet Doors

Hinges: (3 pair) A5111
Latchset: F02 with stainless steel Lever Handles
Flushbolts: L14081 inactive leaf
Dust proof strike: L04021
Silencers: L03011

COHW-18

Pair of TA-50 Corridor Doors (45 minute door system)
W/magnetic hold opens, connected to smoke alarm system

Hinges: (3 pair) A5111
Latchset: F14 with stainless steel Lever Handles
Floor/Top Bolt: L04161 provide dustproof strike
Electromagnetic Door
Holders C00011: 24 volt DC(smoke alarm system)
Closer: C02021 with option Pt4c
Gasketing: S88D Pemko
Kickplates: J106 (black)

COHW-19

Pair of Storage Doors

Hinges: (3 pair) A5111
Latchset: F14 with stainless steel Lever Handles
Floor/Top Bolt: L04161 provide dustproof strike
Closer: C02021 with option Pt4c
Kickplates: J106 (black)
Silencers: L03011
Door holders

NOTE: Manufacturers items mentioned are listed only to communicate performance, color or finish and are not intended to limit products by other manufacturers.

3.7 BATTALION HEADQUARTERS HARDWARE SETS (BHHW)

BHHW-1

Entrance doors

Hinges: (2) Stainless Steel Continuous Hinge SL11HD DKBZ
Exit Device: (1) Grade 1, type 4, function 04 x push pad type
(1) Grade 1, type 4, function 01 x push pad type
Cylinder: (1) 1E7 series
Pulls: (2) J402-250mm
Closer: (2) C02061 with options PT-4C and PT-4D
Stops: (2) L52121
Threshold: J32180
Astragal: By door manufacturer

BHHW-2

Vestibule doors

Hinges: (2) Stainless Steel Continuous Hinge SL11HD DKBZ
Push Bars: (2) J501
Pulls: (2) J402-250mm
Closer: (2) C02061 with options PT-4C and PT-4D
Stops: (2) L52121

BHHW-3

Classroom exit doors

Hinges: Stainless Steel Continuous Hinge
Exit Device: 7-01
Closer: C02061 with options PT-4C and PT-4D
Stops: L52121
Kickplate: J102
Threshold: J32180

BHHW-4

Stair exit door

Hinges: Stainless Steel Continuous Hinge SL11HD DKBZ
Exit Device: (1) Grade 1, type 4, function 01 x push pad type
Cylinder: (1) 1E7 series
Closer: (2) C02021 with options PT-4C and PT-4D
Stop: L52121
Threshold: J32180

BHHW-5 (Not Used)

BHHW-6

Office area doors

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F05 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-7

Door between Corridor and Lobby

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F05 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-8

Door to Stair and Exit

Hinges: (1-1/2 pair) 114mm x 114mm A8111with BHMA 652 finish
Lockset: F01 with stainless steel lever handles
Closer: C02011 with options PT-4C and PT-4D
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-9

Closet Door

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F01 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish

BHHW-10

Storage Room Doors

Hinges: (3 pair) 114mm x 114mm A8111with BHMA 652 finish
Lockset: F05 with stainless steel lever handles
Flush Bolt: L04251
Closer: C02011 with options PT-4C and PT-4D
Stops: L02141 with BHMA 652 finish
Kickplates: J102

BHHW-11

Private Office Door

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F04 with stainless steel lever handles
Stops: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-12

Storage Room Door

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F07 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-13

Sliding Bypass Closet Doors

Provide hardware for sliding doors as required.

BHHW-14

Mechanical Room Doors

Hinges: (3 pair) 114mm x 114mm A8111with BHMA 652 finish
Lockset: F07 with stainless steel lever handles
Flush Bolt: L04251
Closer: C02051 with options PT-4C and PT-4D
Stops: L02141 with BHMA 652 finish
Kickplates: J102

BHHW-15

Maintenance Room Door

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F07 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-16

Rest Room Door

Hinges: (1-1/2 pair) 114mm x 114mm A8111with BHMA 652 finish
Lockset: F01 with stainless steel lever handles
Closer: C02011 with options PT-4C and PT-4D
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-17

Toilet Room Door

Hinges: (1-1/2 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F22 with stainless steel lever handles
Stop: L02141 with BHMA 652 finish
Kickplate: J102

BHHW-18

Vault Door

HARDWARE BY VAULT DOOR SUPPLIER

BHHW19

Sliding Bypass Closet Doors

Provide hardware for sliding doors as required.

BHHW-20

Conference Room Doors

Hinges: (3 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F22 with stainless steel lever handles
Flush Bolt: L04251
Closer: C02011 with options PT-4C and PT-4D
Stops: L02141 with BHMA 652 finish
Kickplates: J102

BHHW-21

Maintenance Area Doors

Hinges: (3 pair) 114mm x 114mm A8131with BHMA 652 finish
Lockset: F07 with stainless steel lever handles
Flush Bolt: L04251
Stops: L02141 with BHMA 652 finish
Kickplates: J102

BHHW-24

Electrical/Mechanical Room Doors

Hinges: Stainless Steel Continuous Hinge
Lockset: F07 with stainless steel lever handles
Stop: L52121
Kickplate: J102
Threshold: J32180

END OF SECTION

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SECTION 08810

GLASS AND GLAZING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; R 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 509	(1994) Elastomeric Cellular Preformed Gasket and Sealing Material
ASTM C 669	(1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 864	(1999) Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 1036	(1991; R 1997) Flat Glass
ASTM C 1048	(1997b) Heat-Treated Flat Glass - Kind HS, Kind FT Coated and Uncoated Glass
ASTM C 1172	(1996e1) Laminated Architectural Flat Glass
ASTM C 1349	(1996) Architectural Flat Glass Clad Polycarbonate
ASTM D 395	(1998) Rubber Property - Compression Set
ASTM E 119	(1998) Fire Tests of Building Construction and Materials
ASTM E 773	(1997) Accelerated Weathering of Sealed Insulating Glass Units
ASTM E 774	(1997) Classification of the Durability of Sealed Insulating Glass Units
ASTM E 1300	(1998) Determining the Minimum Thickness and Type of Glass Required to Resist a Specified Load

AMERICAN SOCIETY OF CIVIL ENGINEERS (ASCE)

ASCE 7 (1995) Minimum Design Loads for Buildings and Other Structures

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1201 Safety Standard for Architectural Glazing Materials

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-378 (Basic) Putty Linseed Oil Type, (for Wood-Sash-Glazing)

GLASS ASSOCIATION OF NORTH AMERICA (GANA)

GANA Glazing Manual (1997) Glazing Manual

GANA Standards Manual (1995) Engineering Standards Manual

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

NFPA 252 (1995) Fire Tests of Door Assemblies

NFPA 257 (1996) Fire Tests for Window and Glass Block Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G

Drawings showing complete details of the proposed setting methods, mullion details, edge blocking, size of openings, frame details, materials, and types and thickness of glass.

SD-03 Product Data

Insulating Glass; G
Glazing Accessories;

Manufacturer's descriptive product data, handling and storage recommendations, installation instructions, and cleaning instructions.

SD-04 Samples

Insulating Glass; G

Two 203 x 254 mm samples of each of the following: tinted glass, and insulating glass units.

SD-07 Certificates

Insulating Glass; G

Certificates stating that the glass meets the specified requirements. Labels or manufacturers marking affixed to the glass will be accepted in lieu of certificates.

1.3 SYSTEM DESCRIPTION

Glazing systems shall be fabricated and installed watertight and airtight to withstand thermal movement and wind loading without glass breakage, gasket failure, deterioration of glazing accessories, and defects in the work. Glazed panels shall comply with the safety standards, as indicated in accordance with ANSI Z97.1. Glazed panels shall comply with indicated wind/snow loading in accordance with ASTM E 1300.

1.4 DELIVERY, STORAGE AND HANDLING

Glazing compounds shall be delivered to the site in the manufacturer's unopened containers. Glass shall be stored indoors in a safe, well ventilated dry location in accordance with manufacturer's instructions, and shall not be unpacked until needed for installation. Glass shall not be stored on site over 1 month.

1.5 PROJECT/SITE CONDITIONS

Glazing work shall not be started until outdoor temperature is above 5 degrees C and rising, unless procedures recommended by glass manufacturer and approved by Contracting Officer are made to warm the glass and rabbet surfaces. Ventilation shall be provided to prevent condensation of moisture on glazing work during installation. Glazing work shall not be performed during damp or raining weather.

1.6 WARRANTY

1.6.1 Insulating Glass

Manufacturer shall warrant the insulating glass to be free of fogging or film formation on the internal glass surfaces caused by failure of the hermetic seal for a period of 10 years from Date of Substantial Completion. Warranty shall be signed by manufacturer.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of glass and glazing with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification that glazing channel surfaces are properly prepared to receive installation of glazing.
- (5) Finished appearance of glazing is consistent with specification.
- (6) Windows and glazed surfaces are cleaned.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 FLOAT GLASS

2.1.1 Annealed Glass

Annealed glass shall be Type I transparent flat type, Class 1 - clear, Quality q3 - glazing select, 89 percent light transmittance, 0.95 percent shading coefficient, conforming to ASTM C 1036 for nominal 3 mm glass thickness. Annealed glass shall be provided for glazed openings not indicated or specified otherwise.

2.1.2 Tinted (Light-Reducing) Glass

Tinted (light-reducing) glass shall be Type I transparent flat type, Class 3-tinted, Quality q3 - glazing select, 75 percent light transmittance, 75 percent shading coefficient, minimums conforming to ASTM C 1036 for nominal 3 mm glass. Color shall be green.

2.1.3 Obscure Glass

Obscure glass shall be used where indicated and meet the requirements for annealed glass with additional etched or sandblasted treatment to provide a translucent character.

2.2 WIRED GLASS

Wired glass shall be Type II flat type, Class 1 - translucent, Quality q8 - glazing, Form 1 - wired and polished both sides, 6 mm thick,, 85 percent light transmittance, , conforming to ASTM C 1036. Wire mesh shall be polished stainless steel Mesh 2 - square. Wired glass for fire-rated windows shall bear an identifying UL label or the label of a nationally recognized testing agency, and shall be rated for 45 minutes when tested in accordance with NFPA 257. Wired glass for fire-rated doors shall be tested as part of a door assembly in accordance with NFPA 252 and shall conform to NFPA 80.

2.3 INSULATING GLASS

Insulating glass shall be Class A preassembled units of dual-seal construction consisting of lites of glass separated by an aluminum, steel, or stainless steel, spacer and dehydrated space conforming to ASTM E 773 and ASTM E 774 Class A. Nominal overall thickness shall

be 25 mm with a 12 mm air space. Spacer shall be roll-formed, with bent or tightly welded or keyed and sealed joints to completely seal the spacer periphery and eliminate moisture and hydrocarbon vapor transmission into airspace through the corners. Primary seal shall be compressed polyisobutylene and the secondary seal shall be a specially formulated silicone. Insulating units shall be installed in windows and doors as indicated. Window unit performance shall be K-Value/Winter Nighttime 2.0 (R-Value/ Winter Nighttime 2.9). Glass types shall be as follows:

2.3.1 Clear Insulating Glass

Glass for exterior pane of insulating units shall be Type I annealed glass, Class 1 - clear, Quality q3 - glazing select, conforming to ASTM C 1036. Obscure glass shall be used where indicated.

2.3.2 Safety Glazing

Provide safety glazing in exterior pane where indicated or required by the International Building Code.

2.3.3 Low-E Insulating Glass

Exterior glass panes of all insulating unit windows shall have a Low-E anti-reflective low-emissivity coating on No. 2 surface (inside surface of exterior pane).

2.3.4 Laminated Glass

Interior glass panes of exterior insulating unit windows shall be laminated glass consisting of two layers of Type I transparent float glass, Class 1-clear, Quality q3 - glazing select, conforming to ASTM C 1036. Glass shall be bonded together with 0.76 mm thick PVB interlayer under pressure, or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172. Color shall be clear.

2.3.5 Tinted Insulating Glass

At South, West and North (construction elevations) exposure walls of Barracks, Glass for exterior pane of insulating units shall be Type I annealed glass, Class 3 - tinted, Quality q3 - glazing select, conforming to ASTM C 1036. Window unit performance shall be K-Value/Winter Nighttime 2.0 (R-Value/ Winter Nighttime 2.9). Obscure glass shall be used where indicated.

2.4 HEAT-TREATED GLASS (SAFETY GLAZING)

Heat-treated glass shall conform to the following requirements. Glass shall be permanently labeled with appropriate markings. Provide safety glazing where indicated or as required by the International Building Code.

2.4.1 Tempered Glass

Tempered glass shall be kind FT fully tempered transparent flat type, Class 1-clear, Condition A uncoated surface, Quality q3 - glazing select, conforming to ASTM C 1048 and GANA Standards Manual.

2.4.2 Heat-Strengthened Glass

Heat-strengthened glass shall be kind HS heat-strengthened transparent flat type, Class 1-clear, Condition A uncoated surface, Quality q3 - glazing select, conforming to ASTM C 1048.

2.5 LAMINATED GLAZINGS

Laminated glass shall consist of two layers of Type I transparent float glass, Class 1-clear, Quality q3 - glazing select, conforming to ASTM C 1036. Glass shall be bonded together with 0.76 mm thick PVB interlayer under pressure, or alternatives such as resin laminates, conforming to requirements of 16 CFR 1201 and ASTM C 1172.

2.6 FIRE/SAFETY RATED GLASS

Fire/safety rated glass shall be laminated Type I transparent flat type, Class 1-clear. Glass shall have a 60 minute rating when tested in accordance with ASTM E 119. Glass shall be permanently labeled with appropriate markings.

2.7 SPANDREL GLASS

Spandrel glass shall be kind HS heat strengthened transparent flat type, Condition B, coated with a colored ceramic material on No. 2 surface, Quality q3 – glazing select, conforming to ASTM C 1048. Glass performance shall be K value/Winter Nighttime 2.0 (R Value/Winter Nighttime 2.9), maximum shading coefficient 0.5.

2.8 MIRRORS

2.8.1 Glass Mirrors

Glass for mirrors shall be Type I transparent flat type, Class 1-clear, Glazing Quality q1 6 mm thick conforming to ASTM C 1036. Glass color shall be clear. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness that shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint, and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.8.2 Mirror Accessories

2.8.2.1 Mastic

Mastic for setting mirrors shall be a polymer type mirror mastic resistant to water, shock, cracking, vibration and thermal expansion. Mastic shall be compatible with mirror backing paint, and shall be approved by mirror manufacturer.

2.8.2.2 Mirror Frames

Mirrors shall be provided with mirror frames where indicated, (J-mold channels) fabricated of one-piece roll-formed Type 304 stainless steel with No. 4 brushed satin finish and concealed fasteners which will keep mirrors snug to wall. Frames shall be 32 x 6 x 6 mm continuous on all edges of mirrors. Concealed fasteners of type to suit wall construction material shall be provided with mirror frames.

2.8.2.3 Mirror Clips

Concealed fasteners of type to suit wall construction material shall be provided with clips.

2.9 GLAZING ACCESSORIES

2.9.1 Preformed Tape

Preformed tape shall be elastomeric rubber extruded into a ribbon of a width and thickness suitable for specific application. Tape shall be of type which will remain resilient, have excellent adhesion, and be chemically compatible to glass, metal, or wood.

2.9.2 Sealant

Sealant shall be elastomeric conforming to ASTM C 920, Type S or M, Grade NS, Class 12.5, Use G, of type chemically compatible with setting blocks, preformed sealing tape and sealants used in manufacturing insulating glass. Color of sealant shall be clear.

2.9.3 Glazing Gaskets

Glazing gaskets shall be extruded with continuous integral locking projection designed to engage into metal glass holding members to provide a watertight seal during dynamic loading, building movements and thermal movements. Glazing gaskets for a single glazed opening shall be continuous one-piece units with factory-fabricated injection-molded corners free of flashing and burrs. Glazing gaskets shall be in lengths or units recommended by manufacturer to ensure against pull-back at corners. Glazing gasket profiles shall be as indicated on drawings.

2.9.3.1 Fixed Glazing Gaskets

Fixed glazing gaskets shall be closed-cell (sponge) smooth extruded compression gaskets of cured elastomeric virgin neoprene compounds conforming to ASTM C 509, Type 2, Option 1.

2.9.3.2 Wedge Glazing Gaskets

Wedge glazing gaskets shall be high-quality extrusions of cured elastomeric virgin neoprene compounds, ozone resistant, conforming to ASTM C 864, Option 1, Shore A durometer between 65 and 75.

2.9.3.3 Aluminum Framing Glazing Gaskets

Glazing gaskets for aluminum framing shall be permanent, elastic, non-shrinking, non-migrating, watertight and weathertight.

2.9.4 Setting and Edge Blocking

Neoprene setting blocks shall be dense extruded type conforming to ASTM D 395, Method B, Shore A durometer between 70 and 90. Edge blocking shall be Shore A durometer of 50 (+ or - 5). Silicone setting blocks shall be required when blocks are in contact with silicone sealant. Profiles, lengths and locations shall be as required and recommended in writing by glass manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

Openings and framing systems scheduled to receive glass shall be examined for compliance with approved shop drawings, GANA Glazing Manual and glass manufacturer's recommendations including size, squareness, offsets at corners, presence and function of weep system, face and edge clearance requirements and effective sealing between joints of glass-framing members. Detrimental materials shall be removed from glazing rabbet and glass surfaces and wiped dry with solvent. Glazing surfaces shall be dry and free of frost. Do not proceed with installation until all aspects are suitable for work and compliant with specification.

3.2 GLAZING INSTALLATION

Glass and glazing work shall be performed in accordance with approved shop drawings, GANA Glazing Manual, glass manufacturer's instructions and warranty requirements. Glass shall be installed with factory labels intact and removed only when instructed. Wired glass and fire/safety rated glass shall be installed in accordance with NFPA 80. Edges and corners shall not be ground, nipped or cut after leaving factory. Springing, forcing or twisting of units during installation will not be permitted. All glazing installations shall provide for the full range of expansion and contraction anticipated by temperature extremes and the performance of adjacent materials.

3.3 MIRROR INSTALLATION

Apply one additional coat of moisture resistant paint, or type recommended by mirror manufacturer, to back of mirror, and allow to dry. Apply mirror mastic to cover not more than 25 percent of back of mirror. Set mirror in support on setting blocks or continuous gasket, press against substrate to ensure bond of adhesive. Leave open ventilation space, 3 mm or more in thickness between mirror and substrate, over 75 percent of mirror area (wherever there is no adhesive). Do not seal off ventilation space at edges of mirror.

3.4 CLEANING

Upon completion of project, outside surfaces of glass shall be washed clean and the inside surfaces of glass shall be washed and polished in accordance with glass manufacturer's recommendations.

3.5 PROTECTION

Glass work shall be protected immediately after installation. Glazed openings shall be identified with suitable warning tapes, cloth or paper flags, attached with non-staining adhesives. Reflective glass shall be protected with a protective material to eliminate any contamination of the reflective coating. Protective material shall be placed far enough away from the coated glass to allow air to circulate to reduce heat buildup and moisture accumulation on the glass. Glass units which are broken, chipped, cracked, abraded, or otherwise damaged during construction activities shall be removed and replaced with new units.

END OF SECTION

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SECTION 09215

VENEER PLASTER

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 472	(1999) Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 587	(1997) Gypsum Veneer Plaster
ASTM C 588/C 588M	(1999) Gypsum Base for Veneer Plasters
ASTM C 645	(2000) Nonstructural Steel Framing Members
ASTM C 754	(1999a) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 844	(1999) Application of Gypsum Base to Receive Gypsum Veneer Plaster
ASTM C 1002	(1998) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases

FACTORY MUTUAL ENGINEERING AND RESEARCH CORPORATION (FM)

FM-02	(1998) Specification for Tested Products Guide
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UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

Drawings showing ceiling framing and furring, special wall framing, and framed openings.

SD-03 Product Data

Materials; G

The manufacturer's descriptive data for veneer plastering materials.

Manufacturer's installation instructions for veneer plastering materials.

SD-07 Certificates

Fire Resistive Construction; G Steel Framing, Furring and Related Items;

Certificates attesting that the steel framing meets the specified requirements, and that fire-resistive partitions meet the ratings shown.

1.3 GENERAL REQUIREMENTS

The work shall conform to ASTM C 587, ASTM C 754, and ASTM C 844. Gypsum veneer plaster shall be applied as a two component system over a special gypsum base. The veneer plaster, gypsum base, and joint reinforcement shall be products of the same manufacturer. The extent and location of veneer plaster shall be as shown on the approved detail drawings. Metal framing is specified herein.

1.4 DELIVERY AND STORAGE

Plaster materials shall be delivered and stored in the manufacturer's original unopened containers. Materials shall be stored off the ground within a completely enclosed structure or completely enclosed within a weathertight covering. Gypsum base and gypsum board shall be stored flat so as to prevent warping, shall be protected from excessive exposure to sunlight, and shall have bundling tape intact immediately prior to use.

1.5 SCHEDULING

Installation shall commence only after the area scheduled for veneer plaster work is completely weathertight. The heating, ventilating, and air-conditioning systems should be complete and in operation prior to application of the plaster. If the mechanical systems cannot be activated before veneer plastering is begun, the plastering may proceed in accordance with an approved plan to maintain the environmental conditions specified below. Plaster shall be applied prior to the installation of finish flooring, ceramic tile and acoustic ceilings.

1.6 ENVIRONMENTAL REQUIREMENTS

The gypsum base shall not be exposed to excessive sunlight prior to plaster application, as bond failure of the plaster may result. A continuous uniform temperature of not less than 10 degrees C and not more than 27 degrees C shall be maintained for at least one week prior to the application of veneer plaster, while the plastering is being done, and for at least one week after the plaster is set. Air supply and distribution devices shall be shielded to prevent any uneven flow of air across the plastered surfaces. The ventilation rate shall be adjusted to prevent rapid drying.

1.7 FIRE RESISTIVE CONSTRUCTION

Partitions and ceilings indicated to be of fire resistive construction shall be built in compliance with designs as shown on the drawings. Fire-rated assembly shall be in accordance with UL Fire Resist Dir for the Design Numbers indicated.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of veneer plaster with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Methods of installation comply with this section and industry standards.
- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Partition and shaft wall enclosures meet or exceed the referenced UL fire resistance directory design.
- (6) Suspended ceiling and wall framing is adequately braced as necessary to prevent failure or cracking at joints and seams.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Materials shall conform to the requirements specified below. Miscellaneous items not otherwise specified shall be as recommended by the veneer plaster system manufacturer and approved prior to use. Powder driven fasteners may be used only when approved in writing.

2.1.1 Steel Framing, Furring, and Related Items

Non-load bearing steel studs, framing and related items shall be in accordance with ASTM C 645.

2.1.1.1 Ceiling Support Materials and Systems

Size ceiling support components to comply with ASTM C754 unless indicated otherwise. Main runners shall comply with ASTM C754, Section 8, Tables 6 and 7; steel channels with rust inhibitive paint finish hot or cold rolled. Hanger wire shall comply with ASTM A641, soft, Class 1 galvanized, supplemented by 22 mm by 22 mm by 16 gauge galvanized steel formed angles, with bolted connections and 8 mm diameter bolts where required. Screws, clips, bolts, cast-in-place concrete inserts or other devices applicable to the indicated method of structural anchorage for ceiling hangers and whose suitability for use intended has been proven through standard construction practices or by certified test data. Size devices for 3 times the calculated load support, except size direct pull out concrete inserts for 5 times the calculated loads.

2.1.1.2 Wall/Partition Support Material

Studs shall comply with ASTM C645; 25 gauge unless otherwise indicated. Depth of section shall be 92 mm unless otherwise indicated. Runners shall match studs; provide type recommended by stud manufacturer for floor and ceiling support of studs and for vertical abutment of veneer plaster work to other work. Provide stud manufacturer's standard clips, shoes, ties, reinforcements, fasteners and other accessories as needed for a complete stud system. Furring members shall comply with ASTM C645; 25 gauge, hat shaped. Fasteners for furring members shall be type and size recommended by furring manufacturer and application indicated.

2.1.2 Vapor Retarder

Vapor retarder shall be as specified in SECTION: NON-BEARING MASONRY VENEER/STEEL STUD WALLS.

2.1.3 Gypsum Base

Gypsum base for veneer plaster shall be in accordance with ASTM C 588/C 588M, regular and Type X, 1200 mm wide, 16 mm thick. Edges shall be square, rounded, or tapered as recommended by the veneer plaster manufacturer.

2.1.4 Gypsum Veneer Plaster

Gypsum veneer plaster shall be in accordance with ASTM C 587. Minimum compressive strength of finish coat plaster shall be 17.2 MPa in accordance with ASTM C 472. Plaster finish shall be smooth trowel textured.

2.1.5 Joint Reinforcement

Joint reinforcement for steel studs shall be minimum 50 mm wide perforated cross fibered paper tape as recommended by the veneer manufacturer.

2.1.6 Joint Compound

Joint compound shall be in accordance with ASTM C 475.

2.1.7 Screws

Screws for the installation of gypsum board shall be in accordance with ASTM C 1002, and shall be type appropriate to use.

2.1.8 Nails

Nails shall be in accordance with ASTM C 514, and shall have corrosion-resistant treatment.

2.1.9 Cornerbead and Edge Trim

Cornerbead and edge trim shall be corrosion protective-coated steel or vinyl or clear anodized aluminum as recommended by the veneer plaster manufacturer. Flanges shall be free of any material that would adversely affect bonding of the plaster.

PART 3 EXECUTION

3.1 STEEL FRAMING

The installation of steel framing shall conform to ASTM C 754. Framing shall be spaced at 400 mm on center maximum. Partitions shall support applied loads such as cabinets and counters without exceeding the permitted deflection.

3.1.1 Partition Framing System

Metal non-load bearing framing and furring system shall be capable of carrying a transverse load of 240 Pa without exceeding either the allowable stress or a deflection of $L/240$. Studs shall be 0.455 mm minimum thickness for partitions having the same material and the same material thickness on both sides. For partitions using 0.455 mm thick studs, the surfacing material shall cover the full height of the partition on both sides, or the stud flanges shall be otherwise supported to insure rigidity. Studs shall be 0.836 mm minimum thickness for partitions having different materials or different material thickness on the two sides. At partition ends, corners, and intersections, and at jambs of openings, studs shall be fastened to runners with screws.

Isolate stud system from transfer of structural loading system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading. Install runner tracks at floors, ceilings and structural walls and columns where veneer plaster stud system abuts other work, except as indicated. Lay out studs to allow vertical joints of base to be at least 200 mm from corners of door frames. Base sheets shall be staggered on opposite sides of partitions so joints always occur on different studs. Provide closer stud spacing as required for curved walls.

3.1.2 Special Framing

Framing for beams, columns, soffits, and other special items shall be built to the sizes, shapes, or forms indicated and shall be rigidly secured at each intersection with wallboard

screws. At wall hung plumbing fixtures, provide multiple studs as required. Provide framing on each side of control joints.

3.1.3 Shaftwall Framing System

Shaftwalls shall be standard, tested designs and metal framing shall be in accordance with the shaftwall manufacturer's printed instructions.

3.1.4 Ceiling Support Suspension Systems

Secure hangers by connecting directly to structure where possible, otherwise connect to inserts, clips or other anchorage devices or fasteners. Space main runners 1200 mm on center and space hangers 1200 mm on center along runners, except as otherwise shown. Level main runners to a tolerance of 6 mm in 3600 mm, measured both lengthwise on each runner and transversely between parallel runners. Wire tile or clip furring members to main runners and to other structural supports as indicated. Space furring channel members 400 mm on center, except as otherwise indicated. Install auxiliary framing at termination of veneer plaster work, as required for support of both gypsum base and other work indicated for support from gypsum base.

3.1.5 Ceiling Openings

Support members shall be provided at ceiling openings such as required for access panels, recessed light fixtures, and for air supply or exhaust. Support members of not less than 38 mm main runner channels and suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members, although not a part of the structural system, shall be provided for attachment or suspension of support members.

3.1.6 Wall Openings

At wall openings the framing system shall provide for the installation and anchorage of the required subframes or finish frames. Steel frames shall be securely attached with wallboard screws through built-in anchors to the nearest stud on each side of the opening. Double studs shall be provided at both jambs of all door openings. The doubled studs shall be 0.836 mm minimum thickness. For doors over 1200 mm wide, double doors, and for extra-heavy doors, the doubled studs shall be 1.4 mm minimum thickness. Door frames shall be fully grouted at the jamb locations with joint compound applied just prior to application of gypsum base.

3.1.7 Blocking

Blocking shall be provided as necessary for mounted equipment. Blocking shall be metal and shall be cut to fit between framing members. Blocking shall be rigidly anchored to the framing members. Under no circumstances will accessories or other wall mounted equipment be anchored directly to the veneer plaster system.

3.2 APPLICATION OF GYPSUM BASE

Gypsum base shall be applied to framing and furring members in accordance with ASTM C 844 and the requirements specified and shall be the type and thickness required by the wall

design. Gypsum wallboard may be used for the base ply in two-ply construction. Gypsum base and wallboard shall be of maximum practical length, using full length boards for vertical application. Installation shall be with separate boards in moderate contact without forcing in place. Direction of application shall be arranged so leading edge of gypsum base is attached to open edge of stud flange. Boards shall be installed tight against the framing so as to eliminate any offset in the face plane between adjoining boards. End joints of adjoining boards shall be staggered. Abutting end and edge joints shall be neatly fitted. Boards shall be cut as required to make neat close joints around openings. Gypsum base may be adhered to gypsum wallboard with an adhesive, except where prohibited by fire rating. In multi-layer construction, joints shall be offset between layers. Joints on opposite faces of the partition shall be offset.

3.2.1 Ceiling Panels

Install ceiling panels in the direction and manner that will minimize the number of end butt joints, and which will avoid end joints in the central area of each ceiling. Stagger end joints at least 300 mm.

3.2.2 High Wall Areas

At stairs and similar high wall areas (in excess of 4000 mm) install panels horizontally with end joints staggered over studs.

3.2.3 Isolation

Isolate edges of gypsum base from abutment with structure, except at floors. Provide 6 mm to 12 mm space for trim and sealant, except as otherwise indicated. Seal space with acoustical sealant, coordinated with trim.

3.2.4 Sound Rated Walls

At all walls indicated for sound control or specific acoustic performance, seal the work at all perimeter edges (including openings and penetrations) with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with manufacturer's recommendations for location of beads, and close off sound flanking paths around or through the work. Apply serpentine bead of sealant, 6 mm minimum diameter under floor track. Provide a similar bead under ceiling or wall track where junction is not otherwise sealed. Where casing bead is used to finish gypsum base at junction of wall or ceiling, provide continuous bead of sealant located so the inner edge of casing bead compresses the sealant. At edge of gypsum base adjacent to floor, apply a bead of sealant before setting base, except at carpeting. Seal around all electrical outlet boxes and other penetrations. Space fasteners in gypsum base in accordance with referenced standards and manufacturer's recommendations, except as otherwise indicated.

3.2.5 Curved Surfaces

Bending radii for arches and other curved surfaces shall be in accordance with ASTM C 844, TABLE 5. Gypsum base shall be bent into place without damaging the face paper. If the base is dampened to facilitate bending, it must be allowed to dry, and a bonding agent shall be applied, before the plaster is applied.

3.2.6 Cavity Shaftwall System

Gypsum backing boards, core boards, and gypsum base shall be installed in accordance with the shaftwall system manufacturer's printed recommendations to achieve the fire rating required.

3.2.7 Control Joints

Control joints in ceilings and walls shall be one piece manufactured products designed for use with a veneer plaster system. Control joints shall be installed where indicated.

3.2.8 Vapor Retarder

Polyethylene vapor retarder shall be installed with joints over framing members, and with joints lapped the full width of the framing members.

3.3 JOINT REINFORCEMENT

Interior angles and flat joints in the gypsum base shall be reinforced prior to application of the veneer plaster. Self-adhering mesh shall not be used. Reinforcement shall be a special mesh reinforcing strip embedded in veneer plaster, or gypsum wallboard joint tape embedded in joint compound.

3.3.1 Fiber Mesh Reinforcing

Mesh reinforcing strips shall be thoroughly embedded in veneer plaster, so that embedment material is both under and covering the reinforcement. Areas of reinforcement shall be allowed to preset, and shall be left rough enough for proper bonding of the plaster coat. Reinforcement shall be set, but not dry, before the application of veneer plaster over the entire area.

3.3.2 Perforated Paper Tape Reinforcing

The paper tape shall be pressed into a bedding coat of setting type joint compound, and immediately covered with a skim coat of the same compound. After the bedding and skim coats are set, a fill coat of joint compound shall be applied. The reinforcement shall be set and dry before application of veneer plaster over the entire area.

3.4 APPLICATION OF GYPSUM VENEER PLASTER

3.4.1 Substrate Preparations

Where veneer plastering or skim coat plastering is shown directly on concrete, masonry or similar substrates, clean and remove surface projections, which might interfere with plaster application. Etch substrate by scrubbing with acid etch solution on previously wetted surface; rinse thoroughly with clean water. Apply bonding agent on dried concrete substrates; comply with manufacturer's instructions. Where veneer plastering shown on gypsum substrates other than gypsum base of the same manufacturer as the plaster, apply bonding agent.

3.4.2 General Plastering Standards

Except where more stringent requirements are indicated, comply with plaster manufacturer's instructions, referenced standards and requirements for fire-resistance ratings, whichever is the most stringent. Grout metal door frames and similar units occurring in the veneer plastering systems, using grout materials recommended by the manufacturer. Grout prior to gypsum base installation where necessary for proper access. Grout frames solidly and continuously where indicated or required for fire-resistance ratings. Omit grout at closed, tubular frames where moisture from grout may not escape.

3.4.3 Plastering

Gypsum veneer plaster shall be applied in accordance with ASTM C 587, and the manufacturer's approved installation instructions where such instructions are additional to or more restrictive than the requirements of ASTM C 587. Minimum plaster thickness shall be as recommended by the manufacturer, but shall in no case be less than 2.0 mm for base coat and 2.0 mm for finish coat of a two-component system.

3.4.4 Mixing

The mixer shall be cleaned between batches to avoid accelerating the setting time. Other plaster materials shall not be added to modify the properties of the veneer plaster. When extreme conditions so demand, small quantities of commercial retarder or accelerator may be added to the mixing water to adjust setting time. The use of retarder or accelerator shall be in strict conformance with the veneer plaster manufacturer's recommendations.

3.4.5 Base Coat

The base coat shall be scratched in, then immediately doubled back using material from the same batch. Voids and imperfections shall be filled, and the plaster leveled to a true surface without the application of water. The final surface shall be roughened to provide a rough and open surface for bonding by brushing or cross-raking with a fine wire rake after the basecoat material has become firm. For application of finish coat, the base coat shall be set and partially dry. If the base coat is totally dry, it shall be dampened before finish coat application.

3.4.6 Finish Coat

The finish coat shall be scratched in, then immediately doubled back using material from the same batch. The surface shall be lightly trowelled without the addition of water, filling voids and imperfections and eliminating surface irregularities. When the plaster has become firm and prior to set, the surface shall be textured or smoothed; as required, to achieve the indicated finish using water sparingly. Allowable finished tolerance shall be not more than 3 mm total offset in 2400 mm for plumb, level, warp and bow. No visible grooves or trowel marks shall be apparent after finish coat installation.

3.5 CLEANUP AND PATCHING

Plaster splashes shall be removed from adjacent surfaces. Defects in the veneer plaster shall be repaired. Plaster surfaces shall be smooth and clean, and in condition to receive the finishing materials that will be applied.

END OF SECTION

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SECTION 09250

GYPSUM WALLBOARD

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.11	(1992) Interior Installation of Cementitious Backup Units
ANSI A118.9	(1992) Test Methods and Specifications for Cementitious Backer Units

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM A 853	(1993; R 1998) Steel Wire, Carbon, for General Use
ASTM B 164	(1998) Nickel-Copper Alloy Rod, Bar, and Wire
ASTM C 36/C 36M	(1999) Gypsum Wallboard
ASTM C 79/C 79M	(2000) Treated Core and Nontreated Core Gypsum Sheathing Board
ASTM C 475	(1994) Joint Compound and Joint Tape for Finishing Gypsum Board
ASTM C 514	(1996) Nails for the Application of Gypsum Board
ASTM C 557	(1999) Adhesive for Fastening Gypsum Wallboard to Wood Framing
ASTM C 630/C 630M	(2000) Water-Resistant Gypsum Backing Board
ASTM C 645	(2000) Nonstructural Steel Framing Members
ASTM C 754	(1999a) Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
ASTM C 840	(1999) Application and Finishing of Gypsum Board
ASTM C 931/C 931M	(1998) Exterior Gypsum Soffit Board

ASTM C 955	(2000a) Load-Bearing (Transverse and Axial) Steel Studs, Runners (Tracks), and Bracing or Bridging for Screw Application of Gypsum Panel Products and Metal Plaster Bases
ASTM C 960/C 960M	(1997) Predecorated Gypsum Board
ASTM C 1002	(2000) Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases
ASTM C 1047	(1999) Accessories for Gypsum Wallboard and Gypsum Veneer Base
ASTM C 1177/C 1177M	(1999) Glass Mat Gypsum Substrate for Use as Sheathing
ASTM C 1178/C 1178M	(1999) Glass Mat Water-Resistant Gypsum Backing Panel

GYPSUM ASSOCIATION (GA)

GA 214	(1996) Recommended Levels of Gypsum Board Finish
GA 216	(1996) Application and Finishing of Gypsum Board
GA 600	(1997) Fire Resistance Design Manual

UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)
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1.2 SYSTEM DESCRIPTION

1.2.1 Fire-Rated Construction

Joints of fire-rated gypsum board enclosures shall be closed and sealed in accordance with UL test requirements or GA requirements, and as required to meet pressurization requirements. Penetrations through rated partitions and ceilings shall be sealed tight in accordance with tested systems. Fire ratings shall be as indicated.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Steel Framing; "G"
Control Joints; "G"
Fire-Resistant Assemblies; "G"

Drawings and installation details for ceiling framing, furring, special wall framing, and framed openings in walls and ceilings.

SD-07 Certificates

Gypsum Board; "G"
Water-Resistant Gypsum Board; "G"
Exterior Gypsum Soffit Board; "G"
Steel Framing; "G"
Fire-Rated Gypsum Board; "G"
Cementitious Backer Units; "G"

Certificates stating that the steel framing and gypsum wallboard meet the specified requirements. Specific certification that the gypsum wallboard contains no asbestos.

1.4 QUALIFICATIONS

Manufacturer shall specialize in manufacturing the types of material specified and shall have a minimum of 5 years of documented successful experience. Installer shall specialize in the type of gypsum board work required and shall have a minimum of 3 years of documented successful experience.

1.5 DELIVERY, STORAGE AND HANDLING

Materials shall be delivered in original containers bearing the name of manufacturer, contents, and brand name. Materials shall be stored off the ground in a weathertight structure for protection. Gypsum boards shall be stacked flat, off floor and supported to prevent sagging and warping. Adhesives and joint materials shall be stored in accordance with manufacturer's printed instructions. Damaged or deteriorated materials shall be removed from jobsite.

1.6 ENVIRONMENTAL CONDITIONS

Environmental conditions for application and finishing of gypsum board shall be in accordance with ASTM C 840. During the application of gypsum board without adhesive, a room temperature of not less than 4 degrees C 40 degrees F shall be maintained. During the application of gypsum board with adhesive, a room temperature of not less than 10 degrees C 50 degrees F shall be maintained for 48 hours prior to application and continuously afterwards until completely dry. Building spaces shall be ventilated to remove water not required for drying joint treatment materials. Drafts shall be avoided during dry hot weather to prevent materials from drying too rapidly.

1.7 LEVEL OF FINISH REQUIREMENTS

Levels of finish shall be as defined by GA-214 and as listed below:

Level 0: Not Used.

Level 1: Not used.

Level 2: All joints and interior angles shall have tape embedded in joint compound and one separate coat of joint compound applied over all joints, angles, fastener heads and accessories. Surface shall be free of excess joint compound. Tool marks and ridges are acceptable.

Areas of use: walls receiving ceramic tile over water resistant gypsum wallboard, only for that portion of the wall covered by tile.

Level 3: Not Used.

Level 4: All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads and accessories. All joint compound shall be smooth and free of tool marks and ridges. Prepare the surface to be coated with a primer/sealer prior to the application of final finishes. See SECTION: PAINTING, GENERAL.

Areas of use: any wall receiving vinyl or fabric wall covering material.

Level 5: All joints and interior angles shall have tape embedded in joint compound and three separate coats of joint compound applied over all joints, angles, fastener heads and accessories. A thin skim coat of joint compound, or a material manufactured especially for this purpose, shall be applied to the entire surface. The surface shall be smooth and free of tool marks and ridges. Prepare the surface to be coated with a primer/sealer prior to the application of finish paint. See SECTION: PAINTING, GENERAL.

Areas of use: all gypsum wallboard surfaces not specified for levels 2 or 4 as indicated above.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of gypsum wallboard with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Partition, shaft, ceiling and fire wall enclosures meet the requirements of the UL Fire Resistance Directory as indicated.
- (4) Shop drawings include explicit identification of coordination with other trades.

- (5) Inspection of vapor retarder for completeness, integrity and seam closure, and repair of any damage found, prior to installation of wallboard.
- (6) Finished surfaces meet criteria and design requirements.
- (7) All concrete floors to remain exposed in finished construction shall be protected from staining or other contamination during gypsum wallboard installation.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 MATERIALS

Materials shall conform to the requirements specified below. Miscellaneous items not otherwise specified shall be as recommended by the wallboard manufacturer and approved prior to use. The long edges of wallboard shall be tapered, except when used as a base layer in a double layer application. Power driven fasteners may be used only when approved in writing by the Contracting Officer's Representative. Thickness of wallboard shall comply with the systems and listed assemblies as detailed on the drawings.

2.1 NON-LOADBEARING STUD WALLS

2.1.1 Studs

Studs for non-loadbearing walls shall conform to ASTM C 645. Studs shall be C-shaped, roll formed steel with minimum uncoated design thickness of 0.45 mm (25 gauge) made from G40 hot-dip galvanized coated sheet.

2.1.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 645. Tracks shall be prefabricated, U-shaped with minimum 25 mm 1 inch flanges, unpunched web, thickness to match studs, made from G40 hot-dip galvanized coated sheet.

2.2 LOADBEARING STUD WALLS

2.2.1 Studs

Studs for loadbearing walls shall conform to ASTM C 955. Studs shall be C-shaped roll formed steel made from minimum G60 hot-dip galvanized coated sheet. Stud sizes and base metal design thickness shall be as shown on drawings.

2.2.2 Runner Tracks

Floor and ceiling runner tracks shall conform to ASTM C 955. Runners shall be prefabricated, U-shaped with minimum 19 mm 3/4 inch flanges, unpunched web, thickness to match studs, made from G60 hot-dip galvanized coated sheet.

2.2.3 Bridging

Bridging for loadbearing walls shall conform to ASTM C 955. Bridging shall be minimum 19 x 19 mm cold-rolled steel channel with weld attachment clips at each stud or V-bar type weld or screw attached to each stud flange. Bridging shall be adequate to provide lateral support for the stud.

2.3 SUSPENDED CEILING FRAMING

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of L/240. Carrying channels shall be formed from minimum 1.40 mm (16 gauge) thick cold-rolled steel, 38 x 19 mm. Furring members shall be formed from cold-rolled steel, 22 x 65 mm. Carrying channels and furring members shall be made from hot-dip galvanized coated sheet.

2.4 GYPSUM BOARD

Gypsum board shall be asbestos-free. Gypsum board shall have square-cut ends, tapered or beveled edges and shall be maximum possible length. Gypsum board thickness shall be as shown.

2.4.1 Standard Gypsum Board

Regular gypsum board shall conform to ASTM C 36/C 36M, and shall be 1200 mm wide.

2.4.2 Fire-Rated Gypsum Board

Fire-rated gypsum board shall conform to ASTM C 36/C 36M, and shall be Type X or Type C as required, 1200 mm wide.

2.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall conform to ASTM C 630/C 630M, Type X where required with water-resistant paper faces, paintable surfaces, and shall be 1200 mm width and maximum permissible length.

2.4.4 Impact Resistant Gypsum Board

Impact resistant gypsum board shall be manufactured to resist surface indentation and enhance impact resistance of the core with additives and surface papers/liners conforming to ASTM C 36/C 1396, Type X. A film substrate shall be adhered to the back of the panel. Film shall be minimum .50 mm "Lexan" or similar material. Impact resistance by ASTM E 695 shall show no failures after 100 impacts. Impact/Penetration Resistance shall be not less than 100 kg. -meters. When tested in accordance with ASTM D 2394, modified. Surface abrasion resistance as tested by ASTM D 4977, modified shall be not greater than .025 mm when tested for 250 cycles.

2.4.5 Abuse Resistant Gypsum Board

Abuse resistant gypsum board shall be manufactured to resist surface indentation, impact and surface abrasion with additives and surface papers/liners conforming to ASTM C 36/C 1396, Type X. Impact resistance by ASTM E 695 shall show no failures after 100 impacts. Impact/Penetration Resistance shall be not less than 8 kg. - meters when tested in accordance with ASTM D 2394, modified. Surface abrasion resistance as tested by ASTM D 4977, modified shall be not greater than .025 mm when tested for 250 cycles.

2.4.6 Shaftwall Liner Panel

Shaftwall liner panel shall conform to UL listing. Liner Panel shall be specifically manufactured for cavity shaftwall system, with water-resistant paper faces, bevel edges, single lengths to fit required conditions, 25.4 mm thick, by 600 mm wide.

2.4.7 Exterior Gypsum Soffit Board

Exterior gypsum soffit board shall conform to ASTM C 931/C 931M, regular Type X, 1200 mm wide.

2.4.8 Exterior Sheathing Board

Exterior sheathing board shall be as specified in SECTION: NONBEARING MASONRY VENEER/STEEL STUD WALLS.

2.5 TRIM, MOLDINGS, AND ACCESSORIES

2.5.1 Taping and Embedding Compound

Taping and embedding compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use in embedding tape at gypsum wallboard joints and fastener heads, and shall be compatible with tape and substrate.

2.5.2 Finishing or Topping Compound

Finishing or topping compound shall conform to ASTM C 475. Compound shall be specifically formulated and manufactured for use as a finishing compound for gypsum board.

2.5.3 All-Purpose Compound

All-purpose compound shall be specifically formulated and manufactured to use as a taping and finishing compound, and shall be compatible with tape and substrate.

2.5.4 Joint Tape

Joint tape shall conform to ASTM C 475 and shall be as recommended by gypsum board manufacturer. Self adhering mesh shall not be used.

2.5.5 Trim, Control Joints, Beads, Stops and Nosings

Items used to protect edges, corners, and to provide architectural features shall be in accordance with ASTM C 1047. Corrosion protective coated steel designed for its intended use. Flanges shall be free of dirt, grease and other materials that may adversely affect the bond of joint treatment. Provide protective metal edging at corners, wall to concrete or precast concrete transitions, transitions to other dissimilar materials, edges of panels exposed to view and all other areas requiring a smooth finished appearance.

2.5.6 Soffit Metal Reveal Screed

Provide 19 mm reveal at soffit to brick veneer and precast concrete elements at all exterior gypsum soffit locations. Thickness of reveal shall be as required to provide a flush finish appearance.

2.6 FASTENINGS AND ADHESIVES

2.6.1 Screws

Screws shall conform to ASTM C 1002. Screws shall be self-drilling and self-tapping steel, Type G for gypsum board to gypsum board and Type S for light-gauge steel framing.

2.6.2 Adhesives

Adhesives shall conform to ASTM C 557. For securing gypsum board to metal framing, adhesive shall be as recommended by gypsum board manufacturer.

2.6.3 Hangers

Suspended ceiling runner channel hangers shall be soft, annealed steel wire not less than No. 8 SWG, conforming to ASTM A 853.

2.6.4 Wire and Clip Type Fastenings

Tie wire, clips, rings, and other fastenings shall be corrosion-resisting steel conforming to ASTM A 580/A 580M, composition 302, 304, or 316, Condition A except that walls, partitions, and other vertical surfaces not incorporated in ceiling construction may be erected with soft, annealed steel conforming to ASTM A 853.

2.6.4.1 Tie Wire

Tie wire for constructing partitions and vertical furring, for securing metal lath to supports, and for lacing shall be not less than No. 18 SWG. Tie wire for other applications shall be not less than No. 16 SWG.

2.6.4.2 Clips

Clips used in lieu of tie wire for securing the furring channels to the runner channels in ceiling construction shall be made from strip not less than 3 mm 1/8 inch thick or shall be hairpin clip, formed of wire not less than 0.4 mm 0.01620 inch nominal diameter. Other clips and rings or

fastenings of similar materials shall be equivalent in holding power to that provided by tie wire for the specific application.

2.7 CEMENTITIOUS BACKER UNITS

Cementitious backer units shall comply with ANSI A118.9.

PART 3 EXECUTION

3.1 INTERIOR WALL FRAMING

Steel framing and furring members shall be installed in accordance with ASTM C 754. Members shall be in alignment with spacings not to exceed the maximum spacings indicated on drawings. Runners shall be aligned accurately at the floor and ceiling and securely anchored. Partition walls that extend to the structural deck above, or to the bottom of steel frame members, shall be constructed with a double top track or slotted connectors to provide for a minimum deflection of 13 mm. Construction of deflection wall head shall be as allowed by UL listed assembly. Installation of steel framing shall conform to ASTM C 754, except that limiting heights shall be according to manufacturer's current published data. Framing shall be spaced as detailed on the drawings with a maximum 400 mm on center. Metal framing and furring systems shall be capable of carrying a transverse load of 24 kg. per square meter without exceeding either the allowable stress or a deflection of L/240.

3.1.1 Wall Openings

The framing system shall provide for the installation and anchorage of the required subframes or finish frames for wall openings at doors, pass-through openings, and access panels. Partitions abutting continuous suspended ceilings shall be strengthened for rigidity at rough openings of more than 750 mm wide. Studs at openings shall be 0.84 mm minimum bare metal thickness and spot grouted at jamb anchor inserts. Double studs shall be fastened together with screws and secured to floor and overhead runners. Two studs shall be used for framing solid-core doors, doors over 900 mm wide and extra-heavy doors.

3.1.2 Wall Control Joints

Control joints for expansion and contraction in the walls shall be constructed with double studs installed 13 mm 1/2 inch apart in interior walls or wall furrings where indicated on drawings. Control joint spacing shall not exceed 9 m. 30 feet. Ceiling-height door frames may be used as vertical control joints. Door frames of less than ceiling height may be used as control joints only if standard control joints extend to ceiling from both corners of top of door frame. Control joints between studs shall be filled with firesafing insulation in fire rated partitions.

3.1.3 Blocking

Blocking shall be provided as necessary for mounted equipment. Blocking shall be metal cut to fit between framing members. Blocking shall be rigidly anchored to the framing members. Under no circumstances will accessories or other wall mounted equipment be anchored directly to gypsum wallboard.

3.1.4 Special Framing

Framing for beams, columns, soffits and other special items/surfaces shall be built to the sizes, shapes or forms indicated and shall be rigidly secured to each intersection with wallboard screws. Construction shall meet UL requirements for assembly related construction indicated.

3.2 SHAFT WALL FRAMING

The shaft wall system shall be installed in accordance with the system manufacturer's published instructions. Bucks, anchors, blocking and other items placed in or behind shaft wall framing shall be coordinated with electrical and mechanical work. Fireproofing materials which are damaged or removed during shaft wall construction shall be patched or replaced.

3.3 SUSPENDED CEILING FRAMING

Suspended ceiling system framing shall be installed in accordance with ASTM C 754 and IBC 2000.

3.3.1 Hangers

Hangers shall be spaced not more than 1200 mm along runner channels and 900 mm in the other direction or 1050 mm in both directions unless otherwise indicated. Locations of hanger wires shall be coordinated with other work. Hangers at ends of runner channels shall be located not more than 150 mm from wall. Hanger wire shall be looped around bottom chord of open-web steel joists, or secured to structural elements with suitable fasteners. Sags or twists that develop in the suspended system shall be adjusted. Damaged or faulty parts shall be replaced. Install suspension system with seismic restraint hangers as required by IBC 2000.

3.3.2 Main Runners

Main runner channels shall be installed in accordance with ASTM C 754. Hanger wires shall be double strand saddle-tied to runner channels and the ends of hanger wire shall be twisted three times around itself. Main runners shall be located to within 150 mm of the paralleling wall to support the ends of cross furring. Main runners shall not come in contact with abutting masonry or concrete walls. Where main runners are spliced, ends shall be overlapped 300 mm with flanges of channels interlocked, and shall be securely tied at each end of splice with wire looped twice around the channels.

3.3.3 Furring Channels

Furring channels shall be spaced in accordance with ASTM C 754. Furring channels shall be secured to the runner channels and to structural supports at each crossing with tie wire, hairpin clips, or equivalent fastenings. Furring channels shall be located within 50 mm of parallel walls and beams, and shall be cut 13 mm short of abutting walls.

3.3.4 Ceiling Openings

Support members shall be provided as required at ceiling openings for access panels, recessed light fixtures, and air supply or exhaust. Support members shall be not less than 38

mm main runner channels and vertically installed suspension wires or straps shall be located to provide at least the minimum support specified herein for furring and wallboard attachment. Intermediate structural members not a part of the structural system, shall be provided for attachment or suspension of support members.

3.3.5 Light Fixtures and Air Diffusers

Light fixtures and air diffusers shall be supported directly from suspended ceiling runners. Wires shall be provided at appropriate locations to carry the weight of recessed or surface mounted light fixtures and air diffusers.

3.3.6 Control Joints

Control joints shall be installed in accordance with ASTM C 840, with the following additional requirements: Door frames of less than ceiling height may be used as control joints only if standard control joints extend to the ceiling from both corners of the top of door frame. In wall lengths of over 30 feet, window openings shall be treated in same manner as shown for doors. Locations shall be at both sides of column furring at each bay. Ceiling control joints for expansion and contraction shall be located where indicated on drawings. A control joint or intermediate blocking shall be installed where ceiling framing members change direction.

3.3.6.1 Interior Ceilings With Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 15 m in either direction nor more than 230 square meters.

3.3.6.2 Interior Ceilings Without Perimeter Relief

Control joints shall be installed so that linear dimensions between control joints shall not exceed 9 m in either direction nor more than 84 square meters.

3.3.6.3 Exterior Ceilings

Control joints shall be installed so the linear dimensions between control joints shall not exceed 9 m in either direction nor more than 84 square meters.

3.4 APPLICATION OF GYPSUM BOARD

Gypsum board shall be installed in accordance with ASTM C 840, GA 214 and GA 216 and as specified. Installation shall also be in accordance with the UL listed requirements for all rated assemblies indicated. Paragraph 17.3.1 GENERAL of ASTM C 840 which permits usage of water resistant gypsum board as a base for adhesive application of ceramic or plastic tile on ceilings, does not apply. Edges and ends of gypsum boards shall be cut to obtain neat fitting joints. End joints of adjoining boards shall be staggered, and shall be staggered on opposite sides of wall. Boards shall be applied with moderate contact without forcing in place. Holes for pipes, fixtures or other small openings shall be cut with a tool that will provide a neat fit. Screws shall be driven so that the heads are slightly below the plane of paper face. Fracturing the paper face or damaging the core shall be avoided. Trim shall be installed at external and internal angles formed by the intersecting gypsum board surfaces with other surfaces. Corner beads shall be installed to vertical and horizontal corners in accordance with manufacturer's published instructions. Boards of maximum practical length

shall be used so that an absolute minimum number of end joints occur. Gypsum board partitions in rooms with ceiling heights less than 3 meters shall have full height boards installed vertically with no end joints in the gypsum installation.

3.4.1 Two-Ply Gypsum Board

Second layer of gypsum board shall be applied perpendicular to first layer with joints staggered and secured with mechanical fasteners.

3.4.3 Water-Resistant Gypsum Board

Water-resistant gypsum board shall be installed at the locations indicated.

3.5 TRIM, MOLDINGS, AND ACCESSORIES INSTALLATION

Trim, moldings and accessories shall be installed in accordance with GA 216.

3.6 GYPSUM BOARD FINISH

Gypsum board shall be finished in accordance with ASTM C 840, GA 214 and GA 216. Plenum areas above ceilings shall be finished to Level 1 in accordance with GA 214. Water resistant gypsum backing board, ASTM C 630/C 630M, to receive ceramic tile shall be finished to Level 2 in accordance with GA 214. Walls and ceilings to receive a heavy-grade wall covering or have textured finish before painting shall be finished to Level 4 in accordance with GA 214. Unless otherwise specified, all gypsum board walls, partitions and ceilings shall be finished to Level 5 in accordance with GA 214.

3.7 APPLICATION OF CEMENTITIOUS BACKER UNITS

Cementitious backer units (CBU) shall be installed in accordance with ANSI A108.11. Fasteners shall be the type designed for cement board application. All areas receiving CBU shall be framed with 18 gauge minimum galvanized steel studs at 400 mm on center. CBU occurring in fire rated wall construction shall be attached and sealed as recommended by manufacturer for 1-hour construction and as indicated by UL assembly referenced.

3.8 FIRE-RESISTANT ASSEMBLIES

Gypsum wallboard construction for fire-rated assemblies shall be in accordance with UL Fire Resist Dir, or GA 600 for the design number indicated on drawings.

3.9 PATCHING

Surface defects and damage shall be corrected as required to leave gypsum board smooth, uniform in appearance, and ready to receive finish as specified.

END OF SECTION

SECTION 09310

CERAMIC TILE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A108.1A	(1992) Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar
ANSI A108.1B	(1992) Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex Portland Cement Mortar
ANSI A108.4	(1992) Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile Setting Epoxy Adhesive
ANSI A108.5	(1992) Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
ANSI A108.6	(1992) Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy
ANSI A108.7	(1992) Electrically Conductive Ceramic Tile Installed with Conductive Dry-Set Portland Cement Mortar
ANSI A108.8	(1992) Installation of Ceramic Tile with Chemical Resistant Furan Mortar and Grout
ANSI A108.10	(1992) Installation of Grout in Tilework
ANSI A118.1	(1992) Dry-Set Portland Cement Mortar
ANSI A118.2	(1992) Conductive Dry-Set Portland Cement Mortar
ANSI A118.3	(1992) Chemical Resistant, Water Cleanable Tile Setting and Grouting Epoxy and Water Cleanable Tile Setting Epoxy Adhesive
ANSI A118.4	(1992) Latex-Portland Cement Mortar

ANSI A118.5	(1992) Chemical Resistant Furan Mortars and Grouts for Tile
ANSI A118.6	(1992) Ceramic Tile Grouts
ANSI A118.9	(1992) Cementitious Backer Units
ANSI A136.1	(1992) Organic Adhesives for Installation of Ceramic Tile
ANSI A137.1	(1988) Ceramic Tile

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 185	(1997) Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
ASTM C 33	(1997) Concrete Aggregates
ASTM C 144	(1997) Aggregate for Masonry Mortar
ASTM C 150	(1997) Portland Cement
ASTM C 206	(1984; R 1997) Finishing Hydrated Lime
ASTM C 207	(1991; R 1997) Hydrated Lime for Masonry Purposes
ASTM C 241	(1990) Abrasion Resistance of Stone Subjected to Foot Traffic
ASTM C 373	(1988; R 1994) Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
ASTM C 648	(1998) Breaking Strength of Ceramic Tile
ASTM C 847	(1995) Metal Lath
ASTM C 1026	(1987; R 1996) Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
ASTM C 1027	(1984; R 1990) Determining Visible Abrasion Resistance of Glazed Ceramic Tile
ASTM C 1028	(1996) Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
ASTM C 1178/C 1178M	(1996) Glass Mat Water-Resistant Gypsum Backing Panel

MARBLE INSTITUTE OF AMERICA (MIA)

MIA Design Manual (1991) Design Manual IV Dimensional Stone

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 99 (1999) Health Care Facilities

TILE COUNCIL OF AMERICA (TCA)

TCA Hdbk (1997) Handbook for Ceramic Tile Installation

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Tile; "G"
Setting-Bed;
Mortar, Grout, and Adhesive; "G"

Manufacturer's catalog data.

Tile; "G"
Mortar and Grout;

Manufacturers preprinted installation and cleaning instructions.

SD-04 Samples

Tile; "G"
Accessories;
Marble Thresholds; "G"

Samples of sufficient size to show color range, pattern, type and joints.

SD-07 Certificates

Tile; "G"
Mortar, Grout, and Adhesive; "G"

Certificates indicating conformance with specified requirements. A master grade certificate shall be furnished for tile.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and hallmarks intact. Materials shall be kept dry, protected from weather, and stored under cover in accordance with manufacturer's instructions.

1.4 ENVIRONMENTAL REQUIREMENTS

Ceramic tile work shall not be performed unless the substrate and ambient temperature is at least 10 degrees C and rising. Temperature shall be maintained above 10 degrees C while the work is being performed and for at least 7 days after completion of the work. When temporary heaters are used they shall be vented to the outside to avoid carbon dioxide damage to new tile work.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of ceramic tile with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Tile installed and coordinated with design layout sketches and adjacent construction.
- (4) Inspection of subfloor to verify proper slope for drainage, completed installation of drains and other permanent construction affecting tile position and pattern coordination.
- (5) Finished surfaces meet criteria and design requirements.
- (6) Protection of tile surfaces until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 TILE

Tile shall be standard grade conforming to ANSI A137.1. Containers shall be grade sealed. Seals shall be marked to correspond with the marks on the signed master grade certificate. Tile shall be impact resistant with a minimum breaking strength for wall tile of 41 kg and 113 kg for floor tile in accordance with ASTM C 648. Tile shall be rated frost resistant by the

manufacturer as determined by ASTM C 1026. Water absorption shall be 0.50 maximum percent in accordance with ASTM C 373. Floor tile shall have a minimum coefficient of friction of 0.60 wet and dry in accordance with ASTM C 1028. Floor tile shall be Class IV-Heavy Traffic, durability classification as rated by the manufacturer when tested in accordance with ASTM C 1027 for abrasion resistance as related to foot traffic.

2.1.1 Mosaic Tile

Ceramic mosaic tile and trim shall be unglazed porcelain, unpolished, with sharply formed face. Tile size shall be 50 x 50 mm. Type, color, pattern and location shall be as indicated on drawings.

2.1.2 Glazed Floor Tile

Glazed floor and trim shall be porcelain, polished and semi-polished, with sharply formed face. Field tile size shall be 300 x 300 mm with accent tile of varying sizes. Type, color, pattern and location shall be as indicated on drawings.

2.1.3 Glazed Wall Tile

Glazed wall tile and trim shall be cushion edged with bright and matte glaze. Tile shall be 108 x 108 mm or 50 mm x 50 mm as indicated on the drawings with accent tiles in 50 x 50 mm and 25 x 25 mm size. Color, pattern and location shall be as noted in drawing.

2.1.4 Accessory Tile

Accessories shall be the built-in type of the same materials and finish as the wall tile. Accessories shall be provided as follows:

Coved bases – use at all vertical to horizontal transitions.

Coved cap – use at curb transition to horizontal surface.

Inside/Outside corner trim – use at all vertical wall inside and outside corner transitions.

Bullnose trim – use at all ceramic tile returning to gypsum or other surface, tops of wainscot.

Soap dish – provide one ceramic tile soap dish per shower area matching the “field” color tile.

2.2 SETTING-BED

The setting-bed shall be composed of the following:

2.2.1 Aggregate for Concrete Fill

Aggregate shall conform to ASTM C 33. Maximum size of coarse aggregate shall not be greater than one-half the thickness of concrete fill.

2.2.2 Portland Cement

Cement shall conform to ASTM C 150, Type I, white for wall mortar and gray for other uses.

2.2.3 Sand

Sand shall conform to ASTM C 144.

2.2.4 Hydrated Lime

Hydrated lime shall conform to ASTM C 206, Type S or ASTM C 207, Type S.

2.2.5 Metal Lath

Metal lath shall be flat expanded type conforming to ASTM C 847, and weighing not less than 1.4 kg/square meter.

2.2.6 Reinforcing Wire Fabric

Wire fabric shall conform to ASTM A 185. Wire shall be either 50 x 50 mm mesh, 16/16 wire or 38 x 50 mm mesh, 16/13 wire.

2.3 WATER

Water shall be potable.

2.4 MORTAR, GROUT, AND ADHESIVE

Mortar, grout, and adhesive shall conform to the following:

2.4.1 Dry-Set Portland Cement Mortar

ANSI A118.1.

2.4.2 Latex-Portland Cement Mortar

ANSI A118.4.

2.4.3 Ceramic Tile Grout

ANSI A118.6; Latex-portland cement grout]. Provide unsanded grout. Follow tile manufacturer's written recommendations for mixing, applying and cleaning. Add only water, latex admixture from grout manufacturer, or Laticrete 3701 at the jobsite. Where latex admixture is used in mortar, do not use water. Use only compatible latex additive in grout with proven history of minimizing efflorescence.

2.4.4 Organic Adhesive

ANSI A136.1, Type I, shall be used only where tile application is indicated over gypsum wallboard.

2.4.5 Cementitious Backer Board

Cementitious backer units, for use as tile substrate over steel stud walls, shall be in accordance with ANSI A118.9. and consistent with SECTION: GYPSUM WALLBOARD. Cementitious backer units shall match the thickness of adjacent Gypsum Wallboard. Where only cementitious backer units are present on a wall, minimum thickness shall be 13 mm.

2.5 MARBLE THRESHOLDS

Marble thresholds shall be of size required by drawings or conditions. Marble shall be Group A as classified by MIA Design Manual. Marble shall have a fine sand-rubbed finish and shall be white or gray in color as approved by the Contracting Officer. Marble abrasion shall be not less than 12.0 when tested in accordance with ASTM C 241.

PART 3 EXECUTION

3.1 PREPARATORY WORK AND WORKMANSHIP

Surface to receive tile shall be inspected and shall conform to the requirements of ANSI A108.1A or ANSI A108.1B for surface conditions for the type setting bed specified and for workmanship. Variations of surface to be tiled shall fall within maximum values shown below:

TYPE	WALLS	FLOORS
Dry-Set Mortar meters	3 mm in 2.4 meters	3.0 mm in 3
Organic Adhesives meters	3 mm in 2.4 meters	1.5 mm in 1
Latex portland cement mortar meters	3 mm in 2.4 meters	3.0 mm in 3

3.2 GENERAL INSTALLATION REQUIREMENTS

Tile work shall not be started until roughing in for mechanical and electrical work has been completed and tested, and built-in items requiring membrane waterproofing have been installed and tested. Floor tile installation shall not be started in spaces requiring wall tile until after wall tile has been installed. Tile in colors and patterns indicated shall be applied in the area shown on the drawings. Tile shall be installed with the respective surfaces in true even planes to the elevations and grades shown. Special shapes shall be provided as required for sills, jambs, recesses, offsets, external corners, and other conditions to provide a complete and neatly finished installation. Tile bases and coves shall be solidly backed with mortar.

3.3 INSTALLATION OF WALL TILE

Wall tile shall be installed in accordance with the TCA Hdbk, method W-221 for solid backing, method W-241 for metal studs or method W-211 for mortar bed construction.

3.3.1 Workable or Cured Mortar Bed

Tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. A 0.102 mm (4 mil) polyethylene membrane, metal lath, and scratch coat shall

also be installed. Workable mortar bed, materials, and installation of tile shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B.

3.3.2 Dry-Set Mortar

Dry-set shall be used to install tile directly over clean, sound, cementitious backer units in accordance with ANSI A108.5.

3.4 INSTALLATION OF FLOOR TILE

Floor tile shall be installed in accordance with TCA Hdbk, method F115 (dry-set mortar) at elevated slabs at the Medium Battalion Headquarters, F112 at slab-on-grade construction. Shower receptors shall be installed in accordance with TCA Hdbk, method B414.

3.4.1 Workable or Cured Mortar Bed

Floor tile shall be installed over a workable mortar bed or a cured mortar bed at the option of the Contractor. Workable mortar bed materials and installation shall conform to ANSI A108.1A. Cured mortar bed and materials shall conform to ANSI A108.1B. Joints between quarry tile shall be between 6 mm and 10 mm in width and shall be uniform in width.

3.4.2 Dry-Set and Latex-Portland Cement

Dry-set or Latex-portland cement mortar shall be used to install tile directly over properly cured, plane, clean concrete slabs in accordance with ANSI A108.5. Latex portland cement shall be used when installing porcelain ceramic tile.

3.4.3 Ceramic Tile Grout

Ceramic Tile grout shall be prepared and installed in accordance with ANSI A108.10.

3.4.4 Waterproofing

Shower pans are specified in SECTION: PLUMBING, GENERAL PURPOSE. Waterproofing under concrete fill shall conform to the requirements of SECTION: BITUMINOUS WATERPROOFING.

3.4.5 Concrete Fill

Concrete fill shall be composed by volume of 1 part portland cement to 3 parts fine aggregate to 4 parts coarse aggregate, and mixed with water to as dry a consistency as practicable. The fill shall be spread, tamped, and screeded to a true plane, and pitched to drains or leveled as shown. Concrete fill shall be thoroughly damp cured before application of setting-bed material. Concrete fill shall be reinforced with one layer of reinforcement, with the uncut edges lapped the width of one mesh and the cut ends and edges lapped not less than 50 mm. Laps shall be tied together with 1.3 mm (18 gauge) wire every 250 mm along the finished edges and every 150 mm along the cut ends and edges. The reinforcement shall be supported and secured in the centers of concrete fills. The mesh shall be continuous; except where expansion joints occur, mesh shall be cut and discontinued across such joints. Reinforced concrete fill shall be provided under the setting-bed where the distance between the under-floor surface and the finished tile floor surface is 50 mm or greater, and shall be of

such thickness that the mortar setting-bed over the concrete fill shall be not less nor more than the thickness required in the specified TCA Hdbk methods.

3.5 INSTALLATION OF MARBLE THRESHOLDS

Thresholds shall be installed where indicated in a manner similar to that of the ceramic tile floor. Thresholds shall be the full width of the opening. Head joints at ends shall not exceed 6 mm in width and shall be grouted full as specified for ceramic tile.

3.6 CONTROL JOINTS

Joints shall be formed as indicated and sealed as specified in SECTION: CAULKING AND SEALANTS.

3.6.1 Walls

Control joints shall be provided at all control joints in backing material. At locations where backing material changes provide a control joint formed to separate materials and prevent tile from bridging dissimilar materials.

3.6.2 Floors

Control joints shall be provided over construction joints, control joints and expansion joints in concrete slabs. Control joints shall also be provided where tile abuts restraining surfaces such as perimeter walls, curbs and columns and at intervals of 7 to 10 meters each way in large floor areas. Expansion joints shall extend through setting-beds and fill.

3.7 CLEANING AND PROTECTING

Upon completion, tile surfaces shall be thoroughly cleaned in accordance with manufacturer's approved cleaning instructions. Acid shall not be used for cleaning glazed tile. Floor tile with resinous grout or with factory mixed grout shall be cleaned in accordance with instructions of the grout manufacturer. After the grout has set, tile wall surfaces shall be given a protective coat of a noncorrosive soap or other approved method of protection. Tiled floor areas shall be covered with building paper before foot traffic is permitted over the finished tile floors. Board walkways shall be laid on tiled floors that are to be continuously used as passageways by workmen. Damaged or defective tiles shall be replaced.

END OF SECTION

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SECTION 09445

RESINOUS FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

ASTM C 722 (1994) Chemical-Resistant Resin Monolithic Surfacing

NATIONAL TERRAZZO & MOSAIC ASSOCIATION (NTMA)

NTMA-01 (1992) Resinous Information Guide

1.2 GENERAL

Resinous flooring in the colors indicated shall be applied in the areas shown. Flooring shall be an epoxy system that conforms to the requirements specified in paragraph 2.01H of Guide Specification for Epoxy Resinous Floors contained in NTMA-01.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Resin-Based Flooring; G

Drawings indicating the type and layout of the floor system, including divider strips and control joint strips.

SD-03 Product Data

Resin Manufacturer's Instructions; G
Installation; G

Resin-based flooring manufacturer's descriptive data, mixing, proportioning, and installation instructions. Maintenance literature for resinous flooring shall be included.

SD-04 Samples

Resin-Based Flooring; G

Two 150 x 150 mm, (minimum) samples of each color of resinous flooring.

SD-07 Certificates

Resin-Based Flooring; G
Qualification of Applicator; G

Certificates indicating conformance with specified requirements and flooring manufacturer's approval of the flooring applicator. Certificate from an approved laboratory showing that the resinous floor coating has been tested and meets the requirements specified.

1.4 QUALIFICATION OF APPLICATOR

Applicator shall be approved by the flooring manufacturer and shall have a minimum of 3 years experience in the application of the materials to be used.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers. Materials shall be kept in a clean, dry, area with temperatures controlled between 10 to 33 degrees C.

1.6 ENVIRONMENTAL REQUIREMENTS

Areas to receive industrial resin-based flooring shall have the slab and atmosphere maintained at a temperature above 10 degrees C for 2 days prior to installation and for 7 days following installation.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of resinous flooring with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Protection of flooring until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 PRIMER

Primer shall be a material recommended by the resin-based flooring manufacturer that will penetrate the pores of the substrate and bond with the topping to form a permanent monolithic bond between the substrate and the topping.

2.2 RESIN

Resin shall be suitable for the type application indicated. Resin shall also conform to the requirements specified in paragraph 2.01A of Guide Specification for Epoxy Resinous contained in NTMA-01.

2.3 FILLERS

Fillers, if required, shall be inert cellulosic, silica, quartz or other hard aggregate material as recommended by the flooring manufacturer and best suited for the resin binder used. Fillers shall be furnished in the quantity necessary to impart the required color and physical characteristics.

2.4 AGGREGATE

Aggregate shall consist of finely graded, brightly colored quartz chips, as selected from manufacturer's standard aggregates.

2.5 METAL STRIPS

Metal strips shall not be lighter than 16-gauge white alloy of zinc and of type and size as recommended by the manufacturer. Expansion type strips for expansion joints shall be filled with neoprene filler. Depths of strips shall be as required for topping thickness.

2.6 GROUT

Grout shall be as recommended by the manufacturer of the resin.

2.7 SEALER

Sealer shall be a colorless product recommended by the resin-based flooring manufacturer. When applied to the resin topping and dry, it shall be non-slip, non-yellowing and resistant to staining.

2.8 COLOR

Color of resinous flooring shall be as shown in drawings.

PART 3 EXECUTION

3.1 PREPARATION OF CONCRETE SUBFLOOR

Installation of the floor topping shall not commence until the concrete substrate is at least 28 days old. Slab areas to receive resinous flooring system shall be acid etched. Concrete surfaces shall otherwise be prepared in accordance with the resin manufacturer's instructions.

3.2 MIXING, PROPORTIONING, AND INSTALLING

Mixing, proportioning, and installing shall be in accordance with the approved instructions of the manufacturer. Strips shall be installed in locations indicated. The topping shall be applied to give a finish thickness of from 5 mm to 8 mm. Bases shall be cove type, cast-in-place with 25 mm radius cove and shall be as shown in drawings.

3.3 CLEANING AND SEALING

The resinous floor system shall be washed with a neutral cleaner and shall be cleaned with a fine abrasive where necessary to remove any stains or cement smears. The cleaned surfaces shall be rinsed. When thoroughly dry, a sealer shall be applied in accordance with the manufacturer's directions.

3.4 PROTECTION

The resinous flooring shall be covered and protected from damage until completion of the work of all other trades.

END OF SECTION

SECTION 09510

ACOUSTICAL CEILINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 635	(2000) Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-In Panel Ceilings
ASTM C 636	(1996) Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
ASTM E 119	(2000) Fire Tests of Building Construction and Materials
ASTM E 580	(2000) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels in Areas Requiring Moderate Seismic Restraint
ASTM E 1264	(1998) Standard Classification for Acoustical Ceiling Products
ASTM E 1414	(2000) Standard Test for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum

ENGINEERING TECHNICAL INSTRUCTIONS AND ENERGY SAVINGS ANALYSIS

TI 809-04	(1998) Seismic Design for Buildings
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UNDERWRITERS LABORATORIES (UL)

UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings;

Drawings showing suspension system, method of anchoring and fastening, details, and reflected ceiling plan.

SD-03 Product Data

Acoustical Ceiling Systems; "G"

Manufacturer's descriptive data, catalog cuts, and installation instructions. Submittals which do not provide adequate data for the product evaluation will be rejected.

SD-04 Samples

Acoustical Units; "G"

Two samples of each type of acoustical unit and each type of suspension grid tee section showing texture, finish, and color.

SD-06 Test Reports

Fire Resistive Ceilings; "G"
Ceiling Attenuation Class and Test; "G"

Reports by an independent testing laboratory attesting that acoustical ceiling systems meet specified sound transmission requirements. Data attesting to conformance of the proposed system to Underwriters Laboratories requirements for the fire endurance rating listed in UL Fire Resist Dir may be submitted in lieu of test reports.

SD-07 Certificates

Acoustical Units; "G"

Certificate attesting that the mineral based acoustical units furnished for the project contains recycled material and showing an estimated percent of such material.

1.3 GENERAL REQUIREMENTS

Acoustical treatment shall consist of sound controlling units mechanically mounted on a ceiling suspension system. The unit size, texture, finish, and color shall be as specified. The Contractor has the option to substitute inch-pound (I-P) Recessed Light Fixtures (RLF) for metric RLF. If the Contractor opts to furnish I-P RLF, other ceiling elements like acoustical ceiling tiles, air diffusers, air registers and grills, shall also be I-P products. The Contractor shall coordinate the whole ceiling system with other details, like the location of access panels and ceiling penetrations, etc., shown on the drawings. If I-P products are used, the Contractor shall be responsible for all associated labor and materials and for the final

assembly and performance of the specified work and products. The location and extent of acoustical treatment shall be as shown on the approved detail drawings. Reclamation of mineral fiber acoustical ceiling panels to be removed from the job site shall be in accordance with paragraph RECLAMATION PROCEDURES.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original unopened containers with brand name and type clearly marked. Materials shall be carefully handled and stored in dry, watertight enclosures. Immediately before installation, acoustical units shall be stored for not less than 24 hours at the same temperature and relative humidity as the space where they will be installed in order to assure proper temperature and moisture acclimation.

1.5 ENVIRONMENTAL REQUIREMENTS

A uniform temperature of not less than 16 degrees C nor more than 29 degrees C and a relative humidity of not more than 70 percent shall be maintained before, during, and after installation of acoustical units.

1.6 SCHEDULING

Interior finish work such as plastering, concrete and terrazzo work shall be complete and dry before installation. Mechanical, electrical, and other work above the ceiling line shall be completed and heating, ventilating, and air conditioning systems shall be installed and operating in order to maintain temperature and humidity requirements.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided. Standard performance guarantee or warranty shall contain an agreement to repair or replace acoustical panels that fail within the warranty period. Failures include, but are not limited to, sagging and warping of panels; rusting and manufacturer's defects of grid system.

1.8 EXTRA MATERIALS

Spare tiles of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Tiles shall be from the same lot as those installed.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of Acoustical Ceilings with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Acoustic ceiling panels meet specified sound absorption and transmission criteria.

- (4) Shop drawings include explicit identification of coordination with other trades.
- (5) Installation is coordinated with interfacing construction to eliminate conflicts.
- (6) All damaged tiles are replaced and soiled tiles are cleaned or replaced.
- (7) Finished surface of ceiling provides a level, consistent plane over the entire face.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 ACOUSTICAL UNITS

Acoustical units shall conform to EPA requirements in accordance with SECTION: RECYCLED / RECOVERED MATERIALS. Acoustical units shall conform to ASTM E 1264, Class A, and the following requirements:

2.1.1 Units for Exposed-Grid System ACT-1 (Company and Battalion Buildings)

Type: III mineral fiber with painted finish. Type III acoustical units shall have a minimum recycled material content of 20 percent.

Minimum NRC: 0.55 when tested on mounting No. E-400

Pattern: D.

Nominal size: 600 by 1200 mm.

Edge detail: Square edge lay-in.

Finish: Factory-applied standard finish white.

Minimum LR coefficient: 1.

2.1.2 Units for Exposed-Grid System ACT-2 (Company and Battalion Buildings)

Type: III mineral fiber with painted finish. Type III acoustical units shall have a minimum recycled material content of 20 percent.

Minimum NRC: 0.55 when tested on mounting No. E-400

Pattern: D.

Nominal size: 600 by 600 mm.

Edge detail: Beveled tegular.

Finish: Factory-applied standard finish (white).

Minimum LR coefficient: 0.80.

Minimum CAC: 40

2.1.3 Units for Exposed-Grid System ACT-3 (Soldier Community Building)

Type: III (mineral fiber with painted finish). Type III acoustical units shall have a minimum recycled material content of 20 percent and be reclaimable.

Minimum NRC: 0.55 when tested on mounting No. E-400

Minimum CAC: 35 by ASTM Procedure E 1414.

Fire Resistance: Class A.

Pattern: nondirectional, medium texture

Nominal size: 600 by 600 by 15 mm.

Edge detail: beveled tegular.

Finish: Factory-applied standard finish (white).

Minimum LR coefficient: 0.80.

Reference product: "Cortega" by Armstrong

2.2 SUSPENSION SYSTEM

Suspension system shall be standard exposed grid with narrow width flange, and shall conform to ASTM C 635 for heavy-duty systems. Surfaces exposed to view shall be aluminum or steel with a factory-applied, white baked-enamel finish. Wall molding shall have a flange of not less than 23 mm. Inside and outside corner caps shall be provided.

Suspended ceiling framing system shall have the capability to support the finished ceiling, light fixtures, air diffusers, and accessories, as shown. The suspension system shall have a maximum deflection of 1/360 of span length. Seismic details shall conform to the guidance in TI 809-04 and ASTM E 580 as shown on the drawings.

2.3 HANGERS

Hangers shall be a minimum of No. 12 gauge galvanized steel wire. Hangers and attachment shall support a minimum 1330 N (300 pound) ultimate vertical load without failure of supporting material or attachment. Provide 6 mm diameter galvanized steel eye bolts with lag screw threads as attachment points to structural steel, minimum load capacity of 2200 N (500 pounds). Shank of eye bolt shall be long enough to allow for a minimum of 25 mm of threaded penetration.

2.4 ACCESS PANELS

Access panels shall match adjacent acoustical units and shall be designed and equipped with suitable framing and fastenings for removal and replacement without damage. Panel shall be not less than 300 by 300 mm or more than 600 by 600 mm. An identification plate of 0.8 mm thick aluminum, 19 mm in diameter, stamped with the letters "AP" and finished the same as the unit, shall be attached near one corner on the face of each access panel.

2.5 FINISHES

Acoustical units and suspension system members shall have manufacturer's standard textures, patterns and finishes as specified. Ceiling suspension system components shall be treated to inhibit corrosion.

2.6 COLORS AND PATTERNS

Colors and patterns for acoustical units and suspension system components shall be as shown on drawings.

2.7 CEILING ATTENUATION CLASS AND TEST

Ceiling attenuation class (CAC) range of acoustical units, when required, shall be determined in accordance with ASTM E 1414. Test ceiling shall be continuous at the partition and shall be assembled in the suspension system in the same manner that the ceiling will be installed on the project. System shall be tested with all acoustical units installed.

PART 3 EXECUTION

3.1 INSTALLATION

Acoustical work shall be provided complete with necessary fastenings, clips, and other accessories required for a complete installation. Mechanical fastenings shall not be exposed in the finished work. Hangers shall be laid out for each individual room or space. Hangers shall be placed to support framing around beams, ducts, columns, grilles, and other penetrations through ceilings. Main runners and carrying channels shall be kept clear of abutting walls and partitions. At least two main runners shall be provided for each ceiling span. Wherever required to bypass an object with the hanger wires, a sub-suspension system shall be installed, so that all hanger wires will be plumb. Splayed hanger wires may be used if an opposite countersplayed wire of the same angle as the first wire is installed and attached to the same supporting member.

3.1.1 Suspension System

Suspension system shall be installed in accordance with ASTM C 635 and ASTM C 636 and as specified herein. There shall be no hanger wires or other loads suspended from the underside of steel decking, or from mechanical or electrical equipment, or any other object that is itself suspended. All light fixtures, air terminal devices and like components integrated into the ceiling system shall be suspended independently of the ceiling suspension system. Provide 4 suspension wires for each item. Attach fixtures to ceiling grid system.

3.1.1.1 Plumb Hangers

Hangers shall be plumb and shall not press against insulation covering ducts and pipes. Maintain 200 mm minimum clearance between suspension wires and all adjacent construction. Hanger wire shall be located not more than 200 mm from the end of all main and cross tees.

3.1.1.2 Splayed Hangers

Where hangers must be splayed (sloped or slanted) around obstructions, the resulting horizontal force shall be offset by bracing, countersplaying, or other acceptable means. Splayed hangers shall also be incorporated to resist seismic loads. Installation shall be as indicated in ASTM C 636. Splay wires shall be provided at all vertical offsets in ceiling plane.

3.1.2 Wall Molding

Wall molding shall be provided where ceilings abut vertical surfaces. Wall molding shall be secured not more than 75 mm from ends of each length and not more than 400 mm on centers between end fastenings. Wall molding springs shall be provided at each acoustical unit in semi-exposed or concealed systems.

3.1.3 Acoustical Units

Acoustical units shall be installed in accordance with the approved installation instructions of the manufacturer. Edges of acoustical units shall be in close contact with metal supports, with each other, and in true alignment. Acoustical units shall be arranged so that units less than one-half width are minimized. Units in exposed-grid system shall be held in place with manufacturer's standard hold-down clips, if required for fire resistance rating.

3.1.4 Compression Struts

Provide compression struts fabricated of light gauge metal at all locations where splay bracing is installed. Struts shall be rigidly attached to main runners and structure.

3.2 CEILING ACCESS PANELS

Ceiling access panels shall be located directly under the items which require access.

3.3 CLEANING

Following installation, dirty or discolored surfaces of acoustical units shall be cleaned and left free from defects. Units that are damaged or improperly installed shall be removed and new units provided as directed.

3.4 RECLAMATION PROCEDURES

Ceiling tile waste, designated for recycling by the Contracting Officer, shall be neatly stacked on 1220 by 1220 mm pallets not higher than 1220 mm. Panels shall be completely dry. Pallets shall then be shrink wrapped and symmetrically stacked on top of each other without falling over. Disposal shall be in accordance with SECTION: CONSTRUCTION AND DEMOLITION WASTE MANAGEMENT.

END OF SECTION

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SECTION 09650

RESILIENT FLOORING

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2240	(199e1) Rubber Property - Durometer Hardness
ASTM D 4078	(1992; R 1996) Water Emulsion Floor Polish
ASTM E 648	(1999) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source
ASTM E 662	(1997) Specific Optical Density of Smoke Generated by Solid Materials
ASTM F 1066	(1999) Vinyl Composition Floor Tile
ASTM F 1303	(1999) Sheet Vinyl Floor Covering with Backing
ASTM F 1344	(1996) Rubber Floor Tile
ASTM F 1700	(1999) Solid Vinyl Floor Tile

1.2 FIRE RESISTANCE REQUIREMENTS

Flooring in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648. The smoke density rating shall be less than 450 when tested in accordance with ASTM E 662.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Resilient Flooring and Accessories; "G"

Manufacturer's descriptive data and installation instructions including cleaning and maintenance instructions.

SD-04 Samples

Flooring; "G"

Three samples of each indicated color and type of flooring and base. Sample size shall be minimum 60 x 100 mm.

SD-06 Test Reports

Resilient Flooring and Accessories;
Moisture Test; G
Adhesion Test; G

Copies of test reports showing that representative product samples of the flooring proposed for use have been tested by an independent testing laboratory within the past three years or when formulation change occurred and conforms to the requirements specified. Independent testing laboratory reports indicating conformance with moisture and adhesion test criteria.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the building site in original unopened containers bearing the manufacturer's name, project identification, and handling instructions. Materials shall be stored in a clean dry area with temperature maintained above 21 degrees C for 2 days prior to installation, and shall be stacked according to manufacturer's recommendations. Materials shall be protected from the direct flow of heat from hot-air registers, radiators and other heating fixtures and appliances.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas to receive resilient flooring shall be maintained at a temperature above 21 degrees C and below 38 degrees C for 2 days before application, during application and 2 days after application. A minimum temperature of 13 degrees C shall be maintained thereafter.

1.6 SCHEDULING

Resilient flooring application shall be scheduled after the completion of other work that would damage the finished surface of the flooring.

1.7 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.8 EXTRA MATERIALS

Extra flooring material of each color and pattern shall be furnished at the rate of 5 tiles for each 1000 tiles installed. Extra materials shall be from the same lot as those installed. Extra base material composed of 6 m of each color shall be furnished.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of Resilient Flooring with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Coordination of concrete mix design for floors to establish appropriate amount of water to minimize schedule disruption of tile installation.
- (4) Tile is installed as indicated on vinyl composition tile layouts.
- (5) Striations of tile are correctly aligned per tile manufacturer's recommendations and this specification.
- (6) Protection of all tile and base materials until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 VINYL-COMPOSITION TILE

Vinyl-composition tile shall conform to ASTM F 1066, Class 2, (through pattern tile), asbestos-free, and shall be 305 x 305 mm and 3.2 mm thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern. Color, pattern and layout as indicated on drawings.

2.2 VINYL-COMPOSITION TILE - SLIP RETARDANT

Slip retardant vinyl-composition tile shall be consistent with ASTM F 1066, but need not conform in total. Tile shall be Class 2, (through pattern tile), asbestos-free, and shall be 305 x 305 mm and 3.2 mm thick. Tile shall have the color and pattern uniformly distributed throughout the thickness of the tile. Tile shall incorporate a textured surface designed expressly for slip resistance. Flooring in any one continuous area shall be from the same lot and shall have the same shade and pattern. Color, pattern and layout as indicated.

Reference Product: Excelon Slip-Retardant VCT "Safety Zone" by Armstrong

2.3 RESILIENT BASE

Base shall be manufacturers standard rubber or vinyl, straight style (installed with carpet) and coved style (installed with resilient flooring). Base shall be 100 mm high and a minimum 3 mm thick. Preformed outside corners shall be furnished. Colors as indicated.

2.4 FEATURE STRIP

Feature strips shall be vinyl, 25 mm wide, and of thickness to match the flooring. Color shall be as indicated.

2.5 TRANSITION STRIP

A vinyl or rubber transition strip tapered to meet abutting material shall be provided.

2.6 ADHESIVE

Adhesive for flooring and wall base shall be as recommended in writing by the flooring manufacturer.

2.7 POLISH

Polish shall conform to ASTM D 4078.

2.8 CAULKING AND SEALANTS

Caulking and sealants shall be in accordance with SECTION 07900 JOINT SEALING.

2.9 MANUFACTURER'S COLOR AND TEXTURE

Color and texture shall be as indicated.

PART 3 EXECUTION

3.1 EXAMINATION/VERIFICATION OF CONDITIONS

The Contractor shall examine and verify that site conditions are in agreement with the design package and shall report all conditions that will prevent a proper installation. The Contractor shall not take any corrective action without written approval from the Contracting Officer.

3.2 SURFACE PREPARATION

Flooring shall be in a smooth, true, level plane, except where indicated as sloped. Before any work under this section is begun, all defects such as rough or scaling concrete, low spots, high spots, and uneven surfaces shall have been corrected, and all damaged portions of concrete slabs shall have been repaired as recommended by the flooring manufacturer. Concrete curing compounds, other than the type that does not adversely affect adhesion, shall be entirely removed from the slabs. Paint, varnish, oils, release agents, sealers, waxers, and adhesives shall be removed, as recommended by the flooring manufacturer.

3.3 MOISTURE TEST

The suitability of the concrete subfloor for receiving the resilient flooring with regard to moisture content shall be determined by a moisture test as recommended by the flooring manufacturer. Moisture test shall be performed by an independent testing laboratory with at least 3 years experience in moisture testing of materials. Moisture tests shall be performed in

multiple floor areas. Moisture tests shall be repeated as necessary until a passing test is obtained.

3.4 ADHESION TEST

Immediately prior to tile installation, and following completion of cleaning of concrete floor surfaces, small patches of adhesive intended for use with tile shall be applied in several locations and allowed to dry overnight. If the adhesive can be peeled easily from the floor surfaces, the floor is not sufficiently dry. Adhesive tests shall be repeated as necessary until a passing test is obtained.

3.5 INSTALLATION OF VINYL-COMPOSITION TILE AND SOLID VINYL TILE

Prior to installation, verify that all surfaces are smooth, clean and level (except where floor slope is indicated) and ready for installation. Tile flooring shall be installed with adhesive in accordance with the manufacturer's written installation instructions. Tile lines and joints shall be kept square, symmetrical, tight, and even. Edge width shall vary as necessary to maintain full-size tiles in the field, but no edge tile shall be less than one-half the field tile size, except where irregular shaped rooms make it impossible. Flooring shall be cut to, and fitted around, all permanent fixtures, built-in furniture and cabinets, pipes, and outlets. Edge tile shall be cut, fitted, and scribed to walls and partitions after field flooring has been applied.

3.6 INSTALLATION OF FEATURE STRIPS

Edge strips shall be secured with adhesive as recommended by the manufacturer. Edge strips shall be provided at locations where flooring termination is higher than the adjacent finished flooring, except at doorways where thresholds are provided.

3.7 INSTALLATION OF RESILIENT BASE

Wall base shall be installed with adhesive in accordance with the manufacturer's written instructions. Base joints shall be tight and base shall be even with adjacent resilient flooring. Voids along the top edge of base at masonry walls shall be filled with caulk. Holes, gaps and seams in gypsum wallboard larger than 25 mm in width shall be filled and sanded flush with surface. Inspect preformed corners for color match with running base. Do not install corners that are not color matched.

3.8 CLEANING

Immediately upon completion of installation of tile in a room or an area, flooring and adjacent surfaces shall be cleaned to remove all surplus adhesive. After installation, flooring shall be washed with a cleaning solution, rinsed thoroughly with clear cold water and given two coats of polish in accordance with manufacturers written instructions. After each polish coat, floors shall be buffed to an even luster with an electric polishing machine. Slip resistant vinyl composition tile shall be cleaned and maintained as recommended by the manufacturer.

3.9 PROTECTION

From the time of laying until acceptance, flooring shall be protected from damage as recommended by the flooring manufacturer. Flooring which becomes damaged, loose, broken, curled, stained or otherwise discolored shall be removed and replaced.

END OF SECTION

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SECTION 09680

CARPET

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC TM 16	(1998) Test Method: Colorfastness to Light
AATCC TM 134	(1996) Test Method: Electrostatic Propensity of Carpets
AATCC TM 165	(1999) Test Method: Colorfastness to Crocking: Carpets - AATCC Crockmeter Method

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 297	(1993; R 1998) Rubber Products - Chemical Analysis
ASTM D 418	(1993; R 1997) Pile Yarn Floor Covering Construction
ASTM D 1423	(1999) Twist in Yarns by the Direct-Counting Method
ASTM D 1667	(1997) Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed-Cell Foam)
ASTM D 3278	(1996e1) Test Methods for Flash Point of Liquids by Small Scale Closed-Cup Apparatus
ASTM D 3676	(1996a) Rubber Cellular Cushion Used for Carpet or Rug Underlay
ASTM D 5116	(2001) Guide for Small –Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
ASTM D 5252	(1998a) Practice for the Operation of the Hexapod Tumble Drum Tester
ASTM D 5417	(1999) Practice for Operation of the Vettermann Drum Tester
ASTM E 648	(1999) Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source

CARPET AND RUG INSTITUTE (CRI)

CRI 104	(1996) Commercial Carpet Installation Standard
	(2002) Green Label Indoor Air Quality Carpet Test

CODE OF FEDERAL REGULATIONS (CFR)

16 CFR 1630	Standard for the Surface Flammability of Carpet and Rugs (FF 1-70)
40 CFR 247	Comprehensive Procurement Guideline for Products Containing Recovered Materials

GERMANY INSTITUTE FOR STANDARDIZATION (DIN)

DIN 54318	(1986) Machine-Made Textile Floor Coverings; Determination of Dimensional Changes Due to the Effects of Varied Water and Heat Conditions; Identical with ISO 2551 Edition 1981
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1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Installation; G, A/S
Molding;

Drawings indicating areas receiving carpet, carpet types, textures and patterns, direction of pile, location of seams, and locations of edge molding.

SD-03 Product Data

Carpet; "G", A/S

Manufacturer's catalog data and printed documentation stating physical characteristics, durability, resistance to fading, and flame resistance characteristics for each type of carpet material and installation accessory.

Surface Preparation; G
Installation; G

Manufacturer's printed installation instructions for the carpet, including preparation of substrate, seaming techniques, and recommended adhesives and tapes.

Regulatory Requirements; G

Report stating that carpet contains recycled materials and/or involvement in a recycling or reuse program. Report shall include percentage of recycled material.

SD-04 Samples

Carpet; "G"
Molding; "G"

- a. Carpet: Two "Production Quality" samples 450 x 450 mm of each carpet proposed for use, showing quality, pattern, and color specified.
- b. Vinyl or Aluminum Moldings: Two pieces of each type at least 300 mm long.

SD-06 Test Reports

Moisture and Alkalinity Tests; G

Test reports of moisture and alkalinity content of concrete slab stating date of test, person conducting the test, and the area tested.

SD-07 Certificates

Carpet; "G"

Certificates of compliance from a laboratory accredited by the National Laboratory Accreditation Program of the National Institute of Standards and Technology attesting that each type of carpet and carpet with cushion material conforms to the standards specified.

Certificates of compliance with the CRI "Green Label" testing program.

SD-10 Operation and Maintenance Data

Carpet; G
Cleaning and Protection; G

Carpet manufacturer's maintenance instructions describing recommended type of cleaning equipment and material, spotting and cleaning methods, and cleaning cycles as required for SECTION: OPERATIONS AND MAINTENANCE MANUALS.

1.3 REGULATORY REQUIREMENTS

Carpet and adhesives shall bear the Carpet and Rug Institute (CRI) Indoor Air Quality (IAQ) label or demonstrate compliance with testing criteria and frequencies through independent laboratory test results. Carpet type bearing the label will indicate that the carpet has been tested using ASTM D 5116 and meets the criteria of the CRI IAQ Carpet Testing Program, and minimizes the impact on indoor air quality. Contractor shall procure carpet in accordance with 40 CFR 247, shall submit a report stating that the carpet contains recycled materials and indicating the actual percentage of recycled material. Contractor shall, as much as possible,

select material manufacturers that reduce pollutant and waste, recycle waste, reuse resources and scrap, and reclaim flooring materials instead of disposing into a landfill. Where possible, product shall be purchased locally to reduce emissions of fossil fuels from transporting.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the site in the manufacturer's original wrappings and packages clearly labeled with the manufacturer's name, brand name, size, dye lot number, and related information. Materials shall be stored in a clean, dry, well ventilated area, protected from damage and soiling, and shall be maintained at a temperature above 16 degrees C for 2 days prior to installation.

1.5 ENVIRONMENTAL REQUIREMENTS

Areas in which carpeting is to be installed shall be maintained at a temperature above 16 degrees C for 2 days before installation, during installation, and for 2 days after installation. A minimum temperature of 13 degrees C shall be maintained thereafter for the duration of the contract. Traffic or movement of furniture or equipment in carpeted area shall not be permitted for 24 hours after installation. Other work which would damage the carpet shall be completed prior to installation of carpet.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties including minimum ten (10) year wear warranty, two (2) year material and workmanship and ten (10) year tuft bind and delamination.

1.7 EXTRA MATERIAL

Extra material from same dye lot consisting of full width continuous broadloom shall be provided for future maintenance. A minimum of 1 percent of total square meters of each carpet type, pattern, and color shall be provided.

1.8 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of carpet and carpet installation with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Installation, including surface preparation, alignment, seams and moldings.
- (5) Cleaning and protection.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL CARPET REQUIREMENTS

Carpet shall be first quality; free of visual blemishes, streaks, poorly dyed areas, fuzzing of pile yarn, spots or stains, and other physical and manufacturing defects. Carpet materials and treatments shall be reasonably non-allergenic and free of other recognized health hazards. All grade carpets shall have a static control construction which gives adequate durability and performance. Maximized use of recovered and/or recycled materials for carpet and cushions, otherwise meeting this specification is encouraged.

2.2 CARPET TYPE CPT-1

2.2.1 Physical Characteristics

Carpet shall comply with the following:

- a. Carpet Construction: Loop Pile.
- b. Type: Broadloom 3.6 m minimum usable carpet
- c. Pile Type: Loop Pile.
- d. Pile Fiber: Commercial 100% branded (federally registered trademark) nylon continuous filament, solution dyed.
- e. Pile or Wire Height: Minimum 6.3 mm in accordance with ASTM D 418.
- f. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.
- g. Finished Pile Yarn Weight: Minimum .95 kg per square meter (28 ounces per square yard). This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
- h. Pile Density: Minimum 4,000.
- i. Backing Materials: Primary backing materials shall be those customarily used and accepted by the trade for each type of carpet. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for glue down is provided.

2.2.2 Performance Requirements

- a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.5-4.0 (Severe) ARR when tested in accordance with either the ASTM D 5252

(Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.

- b. Flammability and Critical Radiant Flux Requirements: Carpet shall comply with 16 CFR 1630. Carpet in corridors and exits shall have a minimum average critical radiant flux of 0.45 watts per square centimeter when tested in accordance with ASTM E 648.
- c. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 18 N (3 pound) average force for cut pile.
- d. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
- e. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.
- g. Smoke Density: Carpet shall pass NBS Smoke Chamber Test – ASTM E-662.
- h. Static Rating: Less than 3.0 KV, Anti-static warranty for life of carpet.
- i. Indoor Air Quality: Carpet shall meet Carpet and Rug Institute Standards for "Green Label" carpet testing program.

2.3 CARPET TYPE BATTALION HEADQUARTERS

2.3.1 Physical Characteristics

Carpet shall comply with the following:

- a. Carpet Construction: Tufted.
- b. Type: Broadloom 3.6 m minimum usable carpet width with exception of corridors and stairs.
- c. Pile Type: Textured loop.
- d. Pile Fiber: Commercial 100% branded (federally registered trademark) soil hiding nylon.
- e. Pile or Wire Height: Minimum 3.5 mm in accordance with ASTM D 418.
- f. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.
- g. Gauge: Minimum 1/10 in accordance with ASTM D 418.
- h. Stitches: Minimum 10 per inch.

- i. Finished Pile Yarn Weight: Minimum 25 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
- j. Pile Density: Minimum 6,590 oz/yd³
- k. Dye Method: Solution dyed.
- l. Backing Materials: Primary backing materials shall be polypropylene. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for glue down is provided.

2.3.2 Performance Requirements

- a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.0-3.5 (Heavy) ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.
- b. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 21 degrees C 70 degrees F in accordance with AATCC TM 134.
- d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 40 N average force for loop pile.
- e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
- f. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.
- g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 440 N/m 2.5 lbs./inch.

2.4 CARPET TYPE COMPANY OPERATIONS BUILDINGS

2.4.1 Physical Characteristics

Carpet shall comply with the following:

- a. Carpet Construction: Tufted.
- b. Type: Broadloom 3.6 m minimum usable carpet width with exception of corridors and stairs.
- c. Pile Type: Pattern loop.

- d. Pile Fiber: Commercial 100% branded (federally registered trademark) soil hiding nylon.
- e. Pile or Wire Height: Minimum 3.5 mm in accordance with ASTM D 418.
- f. Yarn Ply: Minimum 2 in accordance with ASTM D 1423.
- g. Gauge: Minimum 1/10 in accordance with ASTM D 418.
- h. Stitches: Minimum 10 per inch.
- i. Finished Pile Yarn Weight: Minimum 25 ounces per square yard. This does not include weight of backings. Weight shall be determined in accordance with ASTM D 418.
- j. Pile Density: Minimum 6,700 oz/yd³
- k. Dye Method: Solution dyed.
- l. Backing Materials: Primary backing materials shall be polypropylene. Secondary backing to suit project requirements shall be those customarily used and accepted by the trade for each type of carpet, except when a special unitary back designed for glue down is provided.

2.4.2 Performance Requirements

- a. ARR (Appearance Retention Rating): Carpet shall be tested and have the minimum 3.0-3.5 (Heavy) ARR when tested in accordance with either the ASTM D 5252 (Hexapod) or ASTM D 5417 (Vettermann) test methods using the number of cycles for short and long term tests as specified.
- b. Static Control: Static control shall be provided to permanently control static buildup to less than 3.5 kV when tested at 20 percent relative humidity and 21 degrees C 70 degrees F in accordance with AATCC TM 134.
- d. Tuft Bind: Tuft bind force required to pull a tuft or loop free from carpet backing shall be a minimum 40 N average force for loop pile.
- e. Colorfastness to Crocking: Dry and wet crocking shall comply with AATCC TM 165 and shall have a Class 4 minimum rating on the AATCC Color Transference Chart for all colors.
- f. Colorfastness to Light: Colorfastness to light shall comply with AATCC TM 16, Test Option E "Water-Cooled Xenon-Arc Lamp, Continuous Light" and shall have a minimum 4 grey scale rating after 40 hours.
- g. Delamination Strength: Delamination strength for tufted carpet with a secondary back shall be minimum of 440 N/m 2.5 lbs./inch.

2.5 ADHESIVES AND CONCRETE PRIMER

Adhesives and concrete primers for installation of carpet shall be waterproof, nonflammable, meet local air-quality standards, and shall be as required by the carpet manufacturer. Seam adhesive shall be waterproof, non flammable, and non-staining as recommended by the carpet manufacturer. Adhesives flashpoint shall be minimum 60 degrees C in accordance with ASTM D 3278.

2.6 MOLDING

Aluminum molding shall be a hammered surface, pinless clamp-down type, designed for the type of carpet being installed. Finish shall be natural color anodized. Floor flange shall be a minimum 38 mm wide and face shall be a minimum 16 mm wide

2.7 TAPE

Tape for seams shall be as recommended by the carpet manufacturer for the type of seam used in installation.

2.8 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern of all carpets shall be as noted on drawing.

PART 3 EXECUTION

3.1 SURFACE PREPARATION

Carpet shall not be installed on surfaces that are unsuitable and will prevent a proper installation. Holes, cracks, depressions, or rough areas shall be repaired using material recommended by the carpet or adhesive manufacturer. Floor shall be free of any foreign materials and swept broom clean. Before beginning work, subfloor shall be tested with glue and carpet to determine "open time" and bond.

3.2 MOISTURE AND ALKALINITY TESTS

Concrete slab shall be tested for moisture content and excessive alkalinity in accordance with CRI 104. Moisture content shall not exceed a hygrometer reading of 65 percent, or percentage established in writing by carpet manufacturer, which ever is lower.

3.3 PREPARATION OF CONCRETE SUBFLOOR

Installation of the carpeting shall not commence until concrete substrate is at least 90 days old. The concrete surfaces shall be prepared in accordance with instructions of the carpet manufacturer. Type of concrete sealer, when required, shall be compatible with the carpet.

3.4 INSTALLATION

All work shall be performed by installers who are CFI certified (International Certified Floorcovering Installer Association), or manufacturer's approved installers. Installation shall be in accordance with the manufacturer's instructions and CRI 104. Edges of carpet meeting hard surface flooring shall be protected with molding; installation shall be in accordance with

the molding manufacturer's instructions. All areas to receive carpeting shall be vacuumed clean of particulate prior to installation.

3.4.1 Broadloom Installation

Broadloom carpet shall be installed direct glue down and shall be smooth, uniform, and secure, with a minimum of seams. Seams shall be uniform, unnoticeable, and treated with a seam adhesive. Side seams shall be run toward the light where practical and where such layout does not increase the number of seams. Breadths shall be installed parallel, with carpet pile in the same direction. Patterns shall be accurately matched. Cutouts, as at door jambs, columns and ducts shall be neatly cut and fitted securely. Seams at doorways shall be located parallel to and centered directly under doors. Seams shall not be made perpendicular to doors or at pivot points. Seams at changes in directions of corridors shall follow the wall line parallel to the carpet direction. Corridors with widths less than 1.8 m shall have the carpet laid lengthwise down the corridors.

3.5 CLEANING AND PROTECTION

3.5.1 Cleaning

After installation of the carpet, debris, scraps, and other foreign matter shall be removed. Soiled spots and adhesive shall be removed from the face of the carpet with appropriate spot remover. Protruding face yarn shall be cut off and removed. Immediately following installation, carpet shall be vacuumed clean with a commercial, truck mounted vacuum system, or a portable vacuum system equipped with HEPA certified filtration system to remove all loose particulate from the carpet. Immediately prior to installation of furniture (by others), carpet shall be vacuumed a second time.

3.5.2 Protection

The installed carpet shall be protected from soiling and damage with heavy, reinforced, non-staining kraft paper, plywood, or hardboard sheets. Edges of kraft paper protection shall be lapped and secured to provide a continuous cover. Traffic shall be restricted for at least 45 hours. Protective covering shall be removed when directed by the Contracting Officer.

3.6 REMNANTS

Remnants remaining from the installation, consisting of scrap pieces more than 600 mm in dimension with more than 0.6 square meters total, shall be retained and provided to the Contracting Officer. Non-retained scraps shall be removed from site and recycled appropriately.

END OF SECTION

SECTION 09720

WALLCOVERINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423	(1999a) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM F 793	(1993; R 1998) Standard Classification of Wallcovering by Durability Characteristics

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Wallcoverings; G
Manufacturer's Instructions; G

Manufacturer's descriptive data, documentation stating physical characteristics, flame resistance, mildew and germicidal characteristics.

Installation; G

Preprinted installation instructions for wallcovering and accessories.

Maintenance;
Clean-Up;

Preprinted cleaning and maintenance instructions for wallcovering and accessories.

SD-04 Samples

Wallcoverings; G

Samples of each indicated type, pattern, and color of wallcovering. Samples of wall covering shall be minimum 125 x 175 mm and of sufficient size to show pattern repeat. Samples of each indicated type corner guard and wainscot cap.

SD-07 Certificates

Wallcoverings; G

Manufacturer's statement attesting that the product furnished meets or exceeds specification requirements. The statement must; be dated after the award of the contract, state Contractor's name and address, name the project and location, and list the requirements being certified.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the site in manufacturers original unopened containers labeled with manufacturers name, pattern, texture, size and related information. Materials shall be stored in accordance with the manufacturer's instructions in a clean dry ventilated area with temperature maintained above 16 degrees C for two days prior to installation.

1.4 ENVIRONMENTAL REQUIREMENTS

Areas to receive wallcovering shall be maintained at a temperature above 16 degrees C for 7 days before, during, and 7 days after application.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one-year period shall be provided.

1.6 EXTRA MATERIALS

Extra material from the same dye lot consisting of 0.5 m of full-width wallcovering for each 30 linear meters of wallcovering installed shall be provided for maintenance.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of wallcovering with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.

- (4) Wall surfaces and trim are complete and ready for installation of wall covering.
- (5) Wall covering materials are installed plumb with all seams and edges true, flush and smooth.
- (6) Manufacturer's written instructions are followed at all times during storage and installation of materials.
- (7) Surrounding work is protected.
- (8) Completed work is cleaned and protected until acceptance.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 WALLCOVERINGS

Wallcoverings shall be material designed specifically for the specified use. The wallcovering shall contain a non-mercury based mildewcide. The wallcovering shall be type made without the use of cadmium based stabilizers. Wallcovering shall have a Class A flame spread rating of 0-25 and smoke development rating of 0-50 when tested in accordance with ASTM E 84.

2.1.1 Vinyl Wallcovering Type A

Vinyl wallcovering shall be a vinyl coated woven or non-woven fabric with germicidal additives and shall conform to ASTM F 793, Category V Type II, (0.445 to 0.815 kg total weight per square meter and width of 1370 mm).

2.1.2 Fabric Wallcovering Type A

Fabric wallcovering shall be a woven fabric with paper or acrylic backing and shall be colorfast, stain, and soil resistant. Fabric wallcovering shall meet or exceed the following:

- a. Face fiber content: 100 percent polyolefin.
- b. Total weight: 0.6 kg/square meter (17.6 ounces per square yard).
- c. Width: 1370 mm.

2.2 WAINSCOT CAP

Wainscot cap shall be wood, as indicated on drawings. See SECTION: FINISH CARPENTRY.

2.3 PRIMER AND ADHESIVE

Primer and adhesive shall be of a type recommended by the wallcovering manufacturer and shall contain a non-mercury based mildewcide. Adhesive shall be strippable type. Adhesive to install cap shall be of a type recommended by the manufacturer of the wainscot cap.

2.4 COLOR, TEXTURE, AND PATTERN

Color, texture, and pattern shall be as indicated on drawings.

PART 3 EXECUTION

3.1 EXAMINATION

Contractor shall inspect all areas and conditions under which wallcoverings are to be installed. Contractor shall notify in writing of any conditions detrimental to the proper and timely completion of the installation. Work will proceed only when conditions have been corrected and accepted by the installer.

3.2 SURFACE PREPARATION

Wallcovering shall not be applied to surfaces that are rough, that contain stains that will bleed through the wallcovering, or that are otherwise unsuitable for proper installation. Cracks and holes shall be filled and rough spots shall be sanded smooth. Surfaces to receive wallcovering shall be thoroughly dry. Plaster surfaces shall age at least 30 days prior to installation of vinyl wallcoverings. Interior surfaces of exterior masonry walls shall be sealed to prevent moisture penetration, then primed with a wallcovering primer in accordance with the manufacturer's instructions. Moisture content of plaster, concrete, and masonry shall be tested with an electric moisture meter and reading shall be not more than 5 percent. Masonry walls shall have flush joints. Concrete and masonry walls shall be coated with a thin coat of joint compound or cement plaster as a substrate preparation. To promote adequate adhesion of wall lining over masonry walls, the walls shall be primed as recommended by the wall lining manufacturer. Surface of walls shall be primed as required by manufacturer's instructions to permit ultimate removal of wallcovering from the wall surface. Primer shall be allowed to completely dry before adhesive application.

3.3 INSTALLATION

3.3.1 Vinyl and Fabric Wallcovering

Wallcovering shall be installed in accordance with the manufacturer's installation instructions. Glue and adhesive spillage shall be immediately removed from wallcovering face and seams with a remover recommended by the manufacturer. After the installation is complete, the fabric wallcovering shall be vacuumed with a ceiling to floor motion.

3.3.2 Wainscot Cap

Wainscot cap shall be installed where shown on the drawings and in accordance with the manufacturer's printed instructions.

3.4 CLEAN-UP

Upon completion of the work, wallcovering shall be left clean and free of dirt or soiling. Surplus materials, rubbish, and debris resulting from the wallcovering installation shall be removed and area shall be left clean.

END OF SECTION

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SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS (ACGIH)

ACGIH Limit Values	(1991-1992) Threshold Limit Values (TLVs) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs)
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ACGIH TLV-DOC	Documentation of Threshold Limit Values and Biological Exposure Indices
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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A13.1	Scheme for Identification of Piping Systems
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 235	Standard Specification for Mineral Spirits (Petroleum Spirits) (Hydrocarbon Dry Cleaning Solvent)
ASTM D 523	(1999) Standard Test Method for Specular Gloss
ASTM C 669	(1995) Glazing Compounds for Back Bedding and Face Glazing of Metal Sash
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM D 2092	(1995) Preparation of Zinc-Coated (Galvanized) Steel Surfaces for Painting
ASTM D 2824	(1994) Aluminum-Pigmented Asphalt Roof Coatings, Non-Fibered, Asbestos Fibered, and Fibered Without Asbestos
ASTM D 4214	(1998) Evaluating the Degree of Chalking of Exterior Paint Films
ASTM D 4263	(1983; R 1999) Indicating Moisture in Concrete by the Plastic Sheet Method

ASTM D 4444	(1998) Standard Test Methods for Use and Calibration of Hand-Held Moisture Meters
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ASTM F 1869	(1998) Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride
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CODE OF FEDERAL REGULATIONS (CFR)

29 CFR 1910.1000	Air Contaminants
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29 CFR 1910.1001	Asbestos, Tremolite, Anthophyllite, and Actinolite
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29 CFR 1910.1025	Lead
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29 CFR 1926.62	Lead Exposure in Construction
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FEDERAL AVIATION ADMINISTRATION (FAA)

FAA AC 70/7460-1	(Rev J) Obstruction Marking and Lighting
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FEDERAL STANDARDS (FED-STD)

FED-STD-313	(Rev. C) Material Safety Data, Transportation Data and Disposal Data for Hazardous Materials Furnished to Government Activities
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FED-STD-595	(1989 Rev B) Color
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MASTER PAINTERS INSTITUTE (MPI)

MPI 1	(2001) Aluminum Paint
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MPI 2	(2001) Aluminum Heat Resistant Enamel (up to 427 C and 800 F)
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MPI 4	(2001) Interior/Exterior Latex Block Filler
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MPI 5	(2001) Exterior Alkyd Wood Primer
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MPI 6	(2001) Exterior Latex Wood Primer
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MPI 7	(2001) Exterior Oil Wood Primer
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MPI 8	(2001) Exterior Alkyd, Flat
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MPI 9	(2001) Exterior Alkyd Enamel
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MPI 10	(2001) Exterior Latex, Flat
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MPI 11	(2001) Exterior Latex, Semi-Gloss
MPI 13	(2001) Exterior Semi-Transparent Stain (Solvent Based)
MPI 16	(2001) Exterior Solid Color Latex Stain
MPI 19	(2001) Inorganic Zinc Primer
MPI 21	(2001) Heat Resistant Enamel, Gloss, (Up to 205 C or 400 F)
MPI 22	(2001) High Heat Resistant Coating
MPI 23	(2001) Surface Tolerant Metal Primer
MPI 26	(2001) Cementitious Galvanized Metal Primer
MPI 27	(2001) Exterior / Interior Alkyd Floor Enamel, Gloss
MPI 31	(2001) Polyurethane, Moisture Cured, Clear Gloss
MPI 39	(2001) Interior Latex-based Wood Primer
MPI 42	(2001) Latex Stucco and Masonry Textured Coating
MPI 44	Interior Latex, Gloss Level 2
MPI 45	(2001) Interior Primer Sealer
MPI 46	(2001) Interior Enamel Undercoat
MPI 47	(2001) Interior Alkyd, Semi-Gloss
MPI 48	(2001) Interior Alkyd, Gloss
MPI 49	(2001) Interior Alkyd, Flat
MPI 50	(2001) Interior Latex Primer Sealer
MPI 51	(2001) Interior Alkyd, Eggshell
MPI 52	(2001) Interior Latex, Gloss Level 3
MPI 54	(2001) Interior Latex, Semi-Gloss
MPI 56	(2001) Interior Alkyd Dry Fog/Fall

MPI 57	(2001) Interior Oil Modified Clear Urethane, Satin
MPI 59	(2001) Interior/Exterior Alkyd Porch & Floor Enamel, Low Gloss
MPI 60	(2001) Interior/Exterior Latex Porch & Floor Paint, Low Gloss
MPI 68	(2001) Interior/Exterior Latex Porch & Floor Paint, Gloss
MPI 71	(2001) Polyurethane, Moisture Cured, Clear, Flat
MPI 72	(2001) Polyurethane, Two Component, Pigmented, Gloss
MPI 77	(2001) Epoxy Cold Cured, Gloss
MPI 79	(2001) Marine Alkyd Metal Primer
MPI 90	(2001) Interior Wood Stain, Semi-Transparent
MPI 94	(2001) Exterior Alkyd, Semi-Gloss
MPI 95	(2001) Fast Drying Metal Primer
MPI 101	(2001) Cold Curing Epoxy Primer
MPI 107	(2001) Rust Inhibitive Primer (Water-Based)
MPI 108	(2001) High Build Epoxy Marine Coating
MPI 110	(2001) Interior/Exterior High Performance Acrylic
MPI 113	(2001) Elastomeric Coating
MPI 116	(2001) Epoxy Block Filler
MPI 119	(2001) Exterior Latex, High Gloss (acrylic)
MPI 134	(2001) Waterborne Galvanized Primer
MPI 138	(2001) High Performance Latex, White and Tints - MPI Gloss Level 2
MPI 139	(2001) High Performance Latex, White and Tints - MPI Gloss Level 3

MPI 140	(2001) High Performance Architectural Latex - Gloss Level 4
MPI 141	(2001) High Performance Semigloss Latex, White and Tints - Gloss Level 5
MPI 144	(2001) Institutional Low Odor / VOC Interior Latex, Gloss Level 2
MPI 145	(2001) Institutional Low Odor / VOC Interior Latex, Gloss Level 3
MPI 146	Institutional Low Odor/VOC Interior Latex - Gloss Level 4 (a 'satin-like' finish)
MPI 147	(2001) Institutional Low Odor / VOC Interior Latex, Gloss Level 5

COMMERCIAL ITEM DESCRIPTION (CID)

CID A-A-2904	Thinner, Paint, Mineral Spirits, Regular and Odorless
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U.S. DEPARTMENT OF DEFENSE (DOD)

MIL-STD-101	(Rev. B) Color Code for Pipelines and for Compressed Gas Cylinders
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SCIENTIFIC CERTIFICATION SYSTEMS (SCS)

SCS-EPP-SP01-01	(2001) Environmentally Preferable Product Specification for Architectural and Anti-Corrosive Paints
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STEEL STRUCTURES PAINTING COUNCIL (SSPC)

SSPC Guide 6	(1997) Containing Debris Generated During Paint Removal Operations
SSPC Guide 7	(1995) Disposal of Lead-Contaminated Surface Preparation Debris
SSPC QP 1	(1989) Evaluating Qualifications of Painting Contractors (Field Application to Complex Structures)
SSPC PA 1	(2000) Shop, Field, and Maintenance Painting
SSPC PA 3	(1995) Safety in Paint Application

SSPC VIS 1	(1989) Visual Standard for Abrasive Blast Cleaned Steel (Standard Reference Photographs)
SSPC VIS 3	(1993) Visual Standard for Power- and Hand-Tool Cleaned Steel (Standard Reference Photographs)
SSPC VIS 4	(2001) Guide and Reference Photographs for Steel Surfaces Prepared by Waterjetting
SSPC SP 1	(1982) Solvent Cleaning
SSPC SP 2	(1995) Hand Tool Cleaning
SSPC SP 3	(1995) Power Tool Cleaning
SSPC SP 6	(1994) Commercial Blast Cleaning
SSPC SP 7	(1994) Brush-Off Blast Cleaning
SSPC SP 10	(1994) Near-White Blast Cleaning
SSPC SP 12	(1995) Surface Preparation and Cleaning of Steel and Other Hard Materials by High-and Ultra high-Pressure Water Jetting Prior to Recoating
SSPC Paint 18	(1991) Chlorinated Rubber Intermediate Coat Paint

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only or as otherwise designated. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

The current MPI, "Approved Product List" which lists paint by brand, label, product name and product code as of the date of contract award, will be used to determine compliance with the submittal requirements of this specification. The Contractor may choose to use a subsequent MPI "Approved Product List", however, only one list may be used for the entire contract and each coating system is to be from a single manufacturer. All coats on a particular substrate must be from a single manufacturer. No variation from the MPI Approved Products List is acceptable.

Samples of specified materials may be taken and tested for compliance with specification requirements.

In keeping with the intent of Executive Order 13101, "Greening the Government through Waste Prevention, Recycling, and Federal Acquisition", products certified by SCS as meeting SCS-EPP-SP01-01 shall be given preferential consideration over registered products. Products that are registered shall be given preferential consideration over products not carrying any EPP designation.

SD-02 Shop Drawings

Piping identification

Submit color stencil codes

SD-03 Product Data

Coating; G,

Manufacturer's Technical Data Sheets

SD-04 Samples

Color; G,

Submit manufacturer's samples of paint colors. Cross reference color samples to color scheme as indicated.

SD-07 Certificates

Applicator's qualifications

Qualification Testing laboratory for coatings G,

SD-08 Manufacturer's Instructions

Application instructions

Mixing

Detailed mixing instructions, minimum and maximum application temperature and humidity, pot life, and curing and drying times between coats.

Manufacturer's Material Safety Data Sheets

Submit manufacturer's Material Safety Data Sheets for coatings, solvents, and other potentially hazardous materials, as defined in FED-STD-313.

SD-10 Operation and Maintenance Data

Coatings: G,

Preprinted cleaning and maintenance instructions for all coating systems shall be provided.

1.3 APPLICATOR'S QUALIFICATIONS

1.3.1 Contractor Qualification

Submit the name, address, telephone number, FAX number, and e-mail address of the contractor that will be performing all surface preparation and coating application. Submit evidence that key personnel have successfully performed surface preparation and application of coatings on concrete, masonry, ferrous metals, wood, gypsum wallboard and plaster on a minimum of three similar projects within the past three years. List information by individual and include the following:

- a. Name of individual and proposed position for this work.
- b. Information about each previous assignment including:

Position or responsibility

Employer (if other than the Contractor)

Name of facility owner

Mailing address, telephone number, and telex number (if non-US)
of facility owner

Name of individual in facility owner's organization who can be
contacted as a reference

Location, size and description of structure

Dates work was carried out

Description of work carried out on structure

1.4 QUALITY ASSURANCE

1.4.1 Field Samples and Tests

The Contracting Officer may choose up to two coatings that have been delivered to the site to be tested at no cost to the Government. Take samples of each chosen product as specified in the paragraph "Sampling Procedures." Test each chosen product as specified in the paragraph "Testing Procedure." Products that do not conform shall be removed from the job site and replaced with new products that conform to the referenced specification. Testing of replacement products that failed initial testing shall be at no cost to the Government.

1.4.1.1 Sampling Procedure

The Contracting Officer will select paint at random from the products that have been delivered to the job site for sample testing. The Contractor shall provide one liter samples of the selected paint materials. The samples shall be taken in the presence

of the Contracting Officer, and labeled, identifying each sample. Provide labels in accordance with the paragraph "Packaging, Labeling, and Storage" of this specification.

1.4.1.2 Testing Procedure

Provide Batch Quality Conformance Testing for specified products, as defined by and performed by MPI. As an alternative to Batch Quality Conformance Testing, the Contractor may provide Qualification Testing for specified products above to the appropriate MPI product specification, using the third-party laboratory approved under the paragraph "Qualification Testing" laboratory for coatings. The qualification testing lab report shall include the backup data and summary of the test results. The summary shall list all of the reference specification requirements and the result of each test. The summary shall clearly indicate whether the tested paint meets each test requirement. Note that Qualification Testing may take 4 to 6 weeks to perform, due to the extent of testing required.

Submit name, address, telephone number, FAX number, and e-mail address of the independent third party laboratory selected to perform testing of coating samples for compliance with specification requirements. Submit documentation that laboratory is regularly engaged in testing of paint samples for conformance with specifications, and that employees performing testing are qualified. If the Contractor chooses MPI to perform the Batch Quality Conformance testing, the above submittal information is not required, only a letter is required from the Contractor stating that MPI will perform the testing.

1.5 REGULATORY REQUIREMENTS

1.5.1 Environmental Protection

In addition to requirements specified elsewhere for environmental protection, provide coating materials that conform to the restrictions of the local Air Pollution Control District and regional jurisdiction. Paints shall comply with Green Seal standards (GS-11) for VOC content. Notify Contracting Officer of any paint specified herein which fails to conform.

1.5.2 Lead Content

Do not use coatings having a lead content over 0.06 percent by weight of nonvolatile content.

1.5.3 Chromate Content

Do not use coatings containing zinc-chromate or strontium-chromate.

1.5.4 Asbestos Content

Materials shall not contain asbestos.

1.5.5 Mercury Content

Materials shall not contain mercury or mercury compounds.

1.5.6 Silica

Abrasive blast media shall not contain free crystalline silica.

1.5.7 Human Carcinogens

Materials shall not contain ACGIH Limit Values and ACGIH TLV-DOC confirmed human carcinogens (A1) or suspected human carcinogens (A2).

1.6 PACKAGING, LABELING, AND STORAGE

Paints shall be in sealed containers that legibly show the contract specification number, designation name, formula or specification number, batch number, color, quantity, date of manufacture, manufacturer's formulation number, manufacturer's directions including any warnings and special precautions, and name and address of manufacturer. Pigmented paints shall be furnished in containers not larger than 20 liters. Paints and thinners shall be stored in accordance with the manufacturer's written directions, and as a minimum, stored off the ground, under cover, with sufficient ventilation to prevent the buildup of flammable vapors, and at temperatures between 4 to 35 degrees C.

1.7 SAFETY AND HEALTH

Apply coating materials using safety methods and equipment in accordance with the following:

Work shall comply with applicable Federal, State, and local laws and regulations, and with the ACCIDENT PREVENTION PLAN, including the Activity Hazard Analysis as specified in Section 01525, "Safety Requirements" and in Appendix A of EM 385-1-1. The Activity Hazard Analysis shall include analyses of the potential impact of painting operations on painting personnel and on others involved in and adjacent to the work zone.

1.7.1 Safety Methods Used During Coating Application

Comply with the requirements of SSPC PA 3.

1.7.2 Toxic Materials

To protect personnel from overexposure to toxic materials, conform to the most stringent guidance of:

- a. The applicable manufacturer's Material Safety Data Sheets (MSDS) or local regulation.
- b. 29 CFR 1910.1000.

- c. ACGIH Limit Values, threshold limit values.

1.8 ENVIRONMENTAL CONDITIONS

1.8.1 Coatings

Do not apply coating when air or substrate conditions are:

- a. Less than 3 degrees C above dew point;
- b. Below 10 degrees C, or over 35 degrees C, unless specifically pre-approved by the Contracting Officer and the product manufacturer. Under no circumstances shall application conditions exceed manufacturer recommendations.

1.9 COLOR SELECTION

Colors of finish coats shall be as indicated or specified. Where not indicated or specified, colors shall be selected by the Contracting Officer. Manufacturers' names and color identification are used for the purpose of color identification only. Named products are acceptable for use only if they conform to specified requirements. Products of other manufacturers are acceptable if the colors approximate colors indicated and the product conforms to specified requirements.

Tint each coat progressively darker to enable confirmation of the number of coats.

Color, texture, and pattern of wall coating systems shall be as indicated.

1.10 LOCATION AND SURFACE TYPE TO BE PAINTED

1.10.1 Painting Included

Where a space or surface is indicated to be painted, include the following unless indicated otherwise.

- a. Surfaces behind portable objects and surface mounted articles readily detachable by removal of fasteners, such as screws and bolts.
- b. New factory finished surfaces that require identification or color coding and factory finished surfaces that are damaged during performance of the work.
- c. Existing coated surfaces that are damaged during performance of the work.

1.10.1.1 Exterior Painting

Includes new surfaces of the buildings and appurtenances as indicated. Also included are existing coated surfaces made bare by cleaning operations.

1.10.1.2 Interior Painting

Includes new surfaces of the buildings and appurtenances as indicated and existing coated surfaces made bare by cleaning operations. Where a space or surface is indicated to be painted, include the following items, unless indicated otherwise.

- a. Exposed columns, girders, beams, joists, and metal deck; and
- b. Other contiguous surfaces.

1.10.2 Painting Excluded

Do not paint the following unless indicated otherwise.

- a. Surfaces concealed and made inaccessible by panelboards, fixed ductwork, machinery, and equipment fixed in place.
- b. Surfaces in concealed spaces. Concealed spaces are defined as enclosed spaces above suspended ceilings, furred spaces, crawl spaces, elevator shafts and chases.
- c. Steel to be embedded in concrete.
- d. Copper, stainless steel, aluminum, brass, and lead except existing coated surfaces.
- e. Hardware, fittings, and other factory finished items.

1.10.3 Mechanical and Electrical Painting

Includes field coating of interior and exterior new surfaces.

- a. Where a space or surface is indicated to be painted, include the following items unless indicated otherwise.
 - (1) Exposed piping, conduit, and ductwork;
 - (2) Supports, hangers, air grilles, and registers;
 - (3) Miscellaneous metalwork and insulation coverings.
- b. Do not paint the following, unless indicated otherwise:
 - (1) New zinc-coated, aluminum, and copper surfaces under insulation
 - (2) New aluminum jacket on piping
 - (3) New interior ferrous piping under insulation.

1.10.3.1 Fire Extinguishing Sprinkler Systems

Clean, pretreat, prime, and paint new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metalwork, and accessories. Apply coatings to clean, dry surfaces, using clean brushes. Clean the surfaces to remove dust, dirt, rust, and loose mill scale. Immediately after cleaning, provide the metal surfaces with one coat primer per schedules. Shield sprinkler heads with protective covering while painting is in progress. Upon completion of painting, remove protective covering from sprinkler heads. Remove sprinkler heads that have been painted and replace with new sprinkler heads. Provide primed surfaces with the following:

- a. Piping in Unfinished Areas: Provide primed surfaces with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm in attic spaces, spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and spaces where walls or ceiling are not painted or not constructed of a prefinished material.
- b. Piping in Finished Areas: Provide primed surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel applied to a minimum dry film thickness of 0.025 mm. Provide piping with 50 mm wide red enamel bands or self-adhering red plastic bands spaced at maximum of 6 meters intervals throughout the piping systems.

1.10.4 Exterior Painting of Site Work Items

Field coat the following items:

- a. Bollards

1.10.5 MISCELLANEOUS PAINTING

Lettering

Lettering shall be provided as scheduled on the drawings, shall be block type, and shall be black enamel. Samples shall be approved before application.

1.10.6 Definitions and Abbreviations

1.10.6.1 Qualification Testing

Qualification testing is the performance of all test requirements listed in the product specification. This testing is accomplished by MPI to qualify each product for the MPI Approved Product List, and may also be accomplished by Contractor's third party testing lab if an alternative to Batch Quality Conformance Testing by MPI is desired.

1.10.6.2 Batch Quality Conformance Testing

Batch quality conformance testing determines that the product provided is the same as the product qualified to the appropriate product specification. This testing shall only be accomplished by MPI testing lab.

1.10.6.3 Coating

A film or thin layer applied to a base material called a substrate. A coating may be a metal, alloy, paint, or solid/liquid suspensions on various substrates (metals, plastics, wood, paper, leather, cloth, etc.). They may be applied by electrolysis, vapor deposition, vacuum, or mechanical means such as brushing, spraying, calendering, and roller coating. A coating may be applied for aesthetic or protective purposes or both. The term "coating" as used herein includes emulsions, enamels, stains, varnishes, sealers, epoxies, and other coatings, whether used as primer, intermediate, or finish coat. The terms paint and coating are used interchangeably.

1.10.6.4 DFT or dft

Dry film thickness, the film thickness of the fully cured, dry paint or coating.

1.10.6.5 DSD

Degree of Surface Degradation, the MPI system of defining degree of surface degradation. Five (5) levels are generically defined under the Assessment sections in the MPI Maintenance Repainting Manual.

1.10.6.6 EPP

Environmentally Preferred Products, a standard for determining environmental preferability in support of Executive Order 13101.

1.10.6.7 EXT

MPI short term designation for an exterior coating system.

1.10.6.8 INT

MPI short term designation for an interior coating system.

1.10.6.9 micron / microns

The metric measurement for 0.001 mm or one/one-thousandth of a millimeter.

1.10.6.10 mil / mils

The English measurement for 0.001 in or one/one-thousandth of an inch, equal to 25.4 microns or 0.0254 mm.

1.10.6.11 mm

The metric measurement for millimeter, 0.001 meter or one/one-thousandth of a meter.

1.10.6.12 MPI Gloss Levels

MPI system of defining gloss. Seven (7) gloss levels (G1 to G7) are generically defined under the Evaluation sections of the MPI Manuals. Traditionally, Flat refers to G1/G2, Eggshell refers to G3, Semigloss refers to G5, and Gloss refers to G6.

Gloss levels are defined by MPI as follows:

Gloss Level	Description	Units @ 60 degrees	Units @ 85 degrees
G1	Matte or Flat	0 to 5	10 max
G2	Velvet	0 to 10	10 to 35
G3	Eggshell	10 to 25	10 to 35
G4	Satin	20 to 35	35 min
G5	Semi-Gloss	35 to 70	
G6	Gloss	70 to 85	
G7	High Gloss		

Gloss is tested in accordance with ASTM D 523. Historically, the Government has used Flat (G1 / G2), Eggshell (G3), Semi-Gloss (G5), and Gloss (G6).

1.10.6.13 MPI System Number

The MPI coating system number in each Division found in either the MPI Architectural Painting Specification Manual or the Maintenance Repainting Manual and defined as an exterior (EXT/REX) or interior system (INT/RIN). The Division number follows the CSI Master Format.

1.10.6.14 Paint

See Coating definition.

1.10.6.15 REX

MPI short term designation for an exterior coating system used in repainting projects or over existing coating systems.

1.10.6.16 RIN

MPI short term designation for an interior coating system used in repainting projects or over existing coating systems.

PART 2 PRODUCTS

2.1 MATERIALS

Conform to the coating specifications and standards referenced in PART 3. Submit manufacturer's technical data sheets for specified coatings and solvents.

PART 3 EXECUTION

3.1 PROTECTION OF AREAS AND SPACES NOT TO BE PAINTED

Prior to surface preparation and coating applications, remove, mask, or otherwise protect, hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixtures, public and private property, and other such items not to be coated that are in contact with surfaces to be coated. Following completion of painting, workmen skilled in the trades involved shall reinstall removed items. Restore surfaces contaminated by coating materials, to original condition and repair damaged items.

3.2 SURFACE PREPARATION

Remove dirt, splinters, loose particles, grease, oil, disintegrated coatings, and other foreign matter and substances deleterious to coating performance as specified for each substrate before application of paint or surface treatments. Oil and grease shall be removed prior to mechanical cleaning. Cleaning shall be programmed so that dust and other contaminants will not fall on wet, newly painted surfaces. Exposed ferrous metals such as nail heads on or in contact with surfaces to be painted with water-thinned paints, shall be spot-primed with a suitable corrosion-inhibitive primer capable of preventing flash rusting and compatible with the coating specified for the adjacent areas.

3.3 PREPARATION OF METAL SURFACES

3.3.1 Existing and New Ferrous Surfaces

- a. Ferrous Surfaces including Shop-coated Surfaces and Small Areas That Contain Rust, Mill Scale and Other Foreign Substances: Solvent clean or detergent wash in accordance with SSPC SP 1 to remove oil and grease. Where shop coat is missing or damaged, clean according to SSPC SP 2, SSPC SP 3, or SSPC SP 6. Brush-off blast remaining surface in accordance with SSPC SP 7. Shop-coated ferrous surfaces shall be protected from corrosion by treating and touching up corroded areas immediately upon detection.
- b. Surfaces With More Than 20 Percent Rust, Mill Scale, and Other Foreign Substances: Clean entire surface in accordance with SSPC SP 6/SSPC SP 12 WJ-3.
- c. Metal Floor Surfaces to Receive Nonslip Coating: Clean in accordance with SSPC SP 10.

3.3.2 Final Ferrous Surface Condition:

For tool cleaned surfaces, the requirements are stated in SSPC SP 2 and SSPC SP 3. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 3.

For abrasive blast cleaned surfaces, the requirements are stated in SSPC SP 7, SSPC SP 6, and SSPC SP 10. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 1.

For waterjet cleaned surfaces, the requirements are stated in SSPC SP 12. As a visual reference, cleaned surfaces shall be similar to photographs in SSPC VIS 4.

3.3.3 Galvanized Surfaces

- a. New or Existing Galvanized Surfaces With Only Dirt and Zinc Oxidation Products: Clean with solvent, steam, or non-alkaline detergent solution in accordance with SSPC SP 1. If the galvanized metal has been passivated or stabilized, the coating shall be completely removed by brush-off abrasive blast. New galvanized steel to be coated shall not be "passivated" or "stabilized" If the absence of hexavalent stain inhibitors is not documented, test as described in ASTM D 2092, Appendix X2, and remove by one of the methods described therein.
- b. Galvanized with Slight Coating Deterioration or with Little or No Rusting: Water jetting to SSPC SP 12 WJ3 to remove loose coating from surfaces with less than 20 percent coating deterioration and no blistering, peeling, or cracking. Use inhibitor as recommended by the coating manufacturer to prevent rusting.
- c. Galvanized With Severe Deteriorated Coating or Severe Rusting: Water jet to SSPC SP 12 WJ3 degree of cleanliness.

3.3.4 Non-Ferrous Metallic Surfaces

Aluminum and aluminum-alloy, lead, copper, and other nonferrous metal surfaces.

- a. Surface Cleaning: Solvent clean in accordance with SSPC SP 1 and wash with mild non-alkaline detergent to remove dirt and water soluble contaminants.

3.3.5 Terne-Coated Metal Surfaces

Solvent clean surfaces with mineral spirits, ASTM D 235. Wipe dry with clean, dry cloths.

3.3.6 Existing Surfaces with a Bituminous or Mastic-Type Coating

Remove chalk, mildew, and other loose material by washing with a solution of 0.20 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water.

3.4 PREPARATION OF CONCRETE AND CEMENTITIOUS SURFACE

3.4.1 Concrete and Masonry

- a. Curing: Concrete, stucco and masonry surfaces shall be allowed to cure at least 30 days before painting, except concrete slab on grade, which shall be allowed to cure 90 days before painting.
- b. Surface Cleaning: Remove the following deleterious substances.
 - (1) Dirt, Chalking, Grease, and Oil: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, and 6.4 liters of warm water. Then rinse thoroughly with fresh water. For large areas, water blasting may be used.
 - (2) Fungus and Mold: Wash new surfaces with a solution composed of 0.2 liter trisodium phosphate, 0.1 liter household detergent, 1.6 liters 5 percent sodium hypochlorite solution and 4.8 liters of warm water. Rinse thoroughly with fresh water.
 - (3) Paint and Loose Particles: Remove by wire brushing.
 - (4) Efflorescence: Remove by scraping or wire brushing followed by washing with a 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid. Do not allow acid to remain on the surface for more than five minutes before rinsing with fresh water. Do not acid clean more than 0.4 square meter of surface, per workman, at one time.
- c. Cosmetic Repair of Minor Defects: Repair or fill mortar joints and minor defects, including but not limited to spalls, in accordance with manufacturer's recommendations and prior to coating application.
- d. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not to surfaces with droplets of water. Do not apply epoxies to damp vertical surfaces as determined by ASTM D 4263 or horizontal surfaces that exceed 3 lbs of moisture per 1000 square feet in 24 hours as determined by ASTM F 1869. In all cases follow manufacturers recommendations. Allow surfaces to cure a minimum of 30 days before painting.

3.4.2 Gypsum Board, Plaster, and Stucco

- a. Surface Cleaning: Plaster and stucco shall be clean and free from loose matter; gypsum board shall be dry. Remove loose dirt and dust by brushing with a soft brush, rubbing with a dry cloth, or vacuum-cleaning prior to application of the first coat material. A damp cloth or sponge may be used if paint will be water-based.

- b. Repair of Minor Defects: Prior to painting, repair joints, cracks, holes, surface irregularities, and other minor defects with patching plaster or spackling compound and sand smooth.
- c. Allowable Moisture Content: Latex coatings may be applied to damp surfaces, but not surfaces with droplets of water. Do not apply epoxies to damp surfaces as determined by ASTM D 4263. New plaster to be coated shall have a maximum moisture content of 8 percent, when measured in accordance with ASTM D 4444, Method A, unless otherwise authorized. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before preparation for painting.

3.5 PREPARATION OF WOOD AND PLYWOOD SURFACES

3.5.1 New Plywood and Wood Surfaces, Except Floors:

- a. Wood surfaces shall be cleaned of foreign matter.

Surface Cleaning: Surfaces shall be free from dust and other deleterious substances and in a condition approved by the Contracting Officer prior to receiving paint or other finish. Do not use water to clean uncoated wood.
- b. Moisture content of the wood shall not exceed 12 percent as measured by a moisture meter in accordance with ASTM D 4444, Method A, unless otherwise authorized.
- c. Wood surfaces adjacent to surfaces to receive water-thinned paints shall be primed and/or touched up before applying water-thinned paints.
- d. Cracks and Nailheads: Set and putty stop nailheads and putty cracks after the prime coat has dried.
- e. Cosmetic Repair of Minor Defects:
 - (1) Knots and Resinous Wood: Prior to application of coating, cover knots and stains with two or more coats of 1.3-kg-cut shellac varnish, plasticized with 0.14 liters of castor oil per liter. Scrape away existing coatings from knotty areas, and sand before treating. Prime before applying any putty over shellacked area.
 - (2) Open Joints and Other Openings: Fill with whiting putty, linseed oil putty. Sand smooth after putty has dried.
 - (3) Checking: Where checking of the wood is present, sand the surface, wipe and apply a coat of pigmented orange shellac. Allow to dry before paint is applied.
- g. Prime Coat For New Exterior Surfaces: Prime coat trim before wood becomes dirty, warped, or weathered.

3.5.2 Interior Wood Surfaces, Stain Finish

Interior wood surfaces to receive stain shall be sanded. Oak and other open-grain wood to receive stain shall be given a coat of wood filler not less than 8 hours before the application of stain; excess filler shall be removed and the surface sanded smooth.

3.6 APPLICATION

3.6.1 Coating Application

Painting practices shall comply with applicable federal, state and local laws enacted to insure compliance with Federal Clean Air Standards. Apply coating materials in accordance with SSPC PA 1. SSPC PA 1 methods are applicable to all substrates, except as modified herein.

At the time of application, paint shall show no signs of deterioration. Uniform suspension of pigments shall be maintained during application.

Unless otherwise specified or recommended by the paint manufacturer, paint may be applied by brush, roller, or spray. Rollers for applying paints and enamels shall be of a type designed for the coating to be applied and the surface to be coated.

Paints, except water-thinned types, shall be applied only to surfaces that are completely free of moisture as determined by sight or touch.

Thoroughly work coating materials into joints, crevices, and open spaces. Special attention shall be given to insure that all edges, corners, crevices, welds, and rivets receive a film thickness equal to that of adjacent painted surfaces.

Each coat of paint shall be applied so dry film shall be of uniform thickness and free from runs, drops, ridges, waves, pinholes or other voids, laps, brush marks, and variations in color, texture, and finish. Hiding shall be complete.

Touch up damaged coatings before applying subsequent coats. Interior areas shall be broom clean and dust free before and during the application of coating material.

Apply paint to new fire extinguishing sprinkler systems including valves, piping, conduit, hangers, supports, miscellaneous metal work, and accessories. Shield sprinkler heads with protective coverings while painting is in progress. Remove sprinkler heads that have been painted and replace with new sprinkler heads. For piping in unfinished spaces, provide primed surfaces with one coat of red alkyd gloss enamel to a minimum dry film thickness of 0.025 mm. Unfinished spaces include spaces above suspended ceilings, crawl spaces, pipe chases, mechanical equipment room, and space where walls or ceiling are not painted or not constructed of a prefinished material. For piping in finished areas, provide prime surfaces with two coats of paint to match adjacent surfaces, except provide valves and operating accessories with one coat of red alkyd gloss enamel. Upon completion of painting, remove protective covering from sprinkler heads.

- a. Drying Time: Allow time between coats, as recommended by the coating manufacturer, to permit thorough drying, but not to present topcoat

adhesion problems. Provide each coat in specified condition to receive next coat.

- b. Primers, and Intermediate Coats: Do not allow primers or intermediate coats to dry more than 30 days, or longer than recommended by manufacturer, before applying subsequent coats. Follow manufacturer's recommendations for surface preparation if primers or intermediate coats are allowed to dry longer than recommended by manufacturers of subsequent coatings. Each coat shall cover surface of preceding coat or surface completely, and there shall be a visually perceptible difference in shades of successive coats.
- c. Finished Surfaces: Provide finished surfaces free from runs, drops, ridges, waves, laps, brush marks, and variations in colors.
- d. Thermosetting Paints: Topcoats over thermosetting paints (epoxies and urethanes) should be applied within the overcoating window recommended by the manufacturer.
- e. Floors: For nonslip surfacing on level floors, as the intermediate coat is applied, cover wet surface completely with almandite garnet, Grit No. 36, with maximum passing U.S. Standard Sieve No. 40 less than 0.5 percent. When the coating is dry, use a soft bristle broom to sweep up excess grit, which may be reused, and vacuum up remaining residue before application of the topcoat.

3.6.2 Mixing and Thinning of Paints

Reduce paints to proper consistency by adding fresh paint, except when thinning is mandatory to suit surface, temperature, weather conditions, application methods, or for the type of paint being used. Obtain written permission from the Contracting Officer to use thinners. The written permission shall include quantities and types of thinners to use.

When thinning is allowed, paints shall be thinned immediately prior to application with not more than 0.125 L of suitable thinner per liter. The use of thinner shall not relieve the Contractor from obtaining complete hiding, full film thickness, or required gloss. Thinning shall not cause the paint to exceed limits on volatile organic compounds. Paints of different manufacturers shall not be mixed.

3.6.3 Two-Component Systems

Two-component systems shall be mixed in accordance with manufacturer's instructions. Any thinning of the first coat to ensure proper penetration and sealing shall be as recommended by the manufacturer for each type of substrate.

3.6.4 Coating Systems

- a. Systems by Substrates: Apply coatings that conform to the respective specifications listed in the following Tables:

Table

Division 5. Exterior Metal, Ferrous and Non-Ferrous Paint Table

Division 6. Exterior Wood; Dressed Lumber, Paneling, Decking,
Shingles Paint Table

Division 3. Interior Concrete Paint Table

Division 4. Interior Concrete Masonry Units Paint Table

Division 5. Interior Metal, Ferrous and Non-Ferrous Paint Table

Division 6. Interior Wood Paint Table

Division 9. Interior Plaster and Gypsum Board Paint Table

- b. Minimum Dry Film Thickness (DFT): Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a minimum dry film thickness of 0.038 mm each coat unless specified otherwise in the Tables. Coating thickness where specified, refers to the minimum dry film thickness.
- c. Coatings for Surfaces Not Specified Otherwise: Coat surfaces that have not been specified, the same as surfaces having similar conditions of exposure.
- d. Existing Surfaces Damaged During Performance of the Work, Including New Patches In Existing Surfaces: Coat surfaces with the following:
 - (1) One coat of primer.
 - (2) One coat of undercoat or intermediate coat.
 - (3) One topcoat to match adjacent surfaces.
- e. Existing Coated Surfaces To Be Painted: Apply coatings conforming to the respective specifications listed in the Tables herein, except that pretreatments, sealers and fillers need not be provided on surfaces where existing coatings are soundly adhered and in good condition. Do not omit undercoats or primers.

3.7 COATING SYSTEMS FOR METAL

Apply coatings of Tables in Division 5 for Exterior and Interior.

- a. Apply specified ferrous metal primer on the same day that surface is cleaned, to surfaces that meet all specified surface preparation requirements at time of application.
- b. Inaccessible Surfaces: Prior to erection, use one coat of specified primer on metal surfaces that will be inaccessible after erection.
- c. Shop-primed Surfaces: Touch up exposed substrates and damaged coatings to protect from rusting prior to applying field primer.
- d. Surface Previously Coated with Epoxy or Urethane: Apply MPI 101, 0.038 mm DFT immediately prior to application of epoxy or urethane coatings.

- e. Pipes and Tubing: The semitransparent film applied to some pipes and tubing at the mill is not to be considered a shop coat, but shall be overcoated with the specified ferrous-metal primer prior to application of finish coats.
- f. Exposed Nails, Screws, Fasteners, and Miscellaneous Ferrous Surfaces. On surfaces to be coated with water thinned coatings, spot prime exposed nails and other ferrous metal with latex primer MPI 107.

3.8 COATING SYSTEMS FOR CONCRETE AND CEMENTITIOUS SUBSTRATES

Apply coatings of Tables in Division 3, 4 and 9 for Exterior and Interior.

3.9 COATING SYSTEMS FOR WOOD AND PLYWOOD

- a. Apply coatings of Tables in Division 6 for Exterior and Interior.
- b. Prior to erection, apply two coats of specified primer to treat and prime wood and plywood surfaces that will be inaccessible after erection.
- c. Apply stains in accordance with manufacturer's printed instructions.

3.10 PIPING IDENTIFICATION

Piping Identification shall be provided for all piping in exposed areas, accessible pipe spaces and surfaces in concealed spaces. Place identification in clearly visible locations. Pipes shall be provided with color band and titles adjacent to all valves, except those provided at plumbing fixtures, at not more than 12 000 mm spacing on straight pipe runs, adjacent to change in direction, and on both sides where pipes pass through walls or floors. Color code marking shall be of the color listed in TABLE I and the size listed in TABLE II. The arrows shall be installed adjacent to each band to indicate the direction of flow in the pipe. The legends shall be printed in upper-case black letters as listed in TABLE I. Letter sizes shall be as listed in TABLE II. Marking shall be painted or applied using colored, pressure-sensitive adhesive markers of standard manufacture. Paint shall be as specified for insulated and uninsulated piping.

TABLE I. COLOR CODES FOR MARKING PIPE

Material	Band	Letters and Arrow*	Legend
Cold water (potable)	Green	White	POTABLE WATER
Fire protection water	Red	White	FIRE PR.
WATER			
Fire Sprinkler Water	Red	White	FIRE SPR.
WATER			
Hot water (domestic)	Green	White	H.W.
Hot water recirculating (domestic)	Green	White	H.W.R.
High temp. water supply	Yellow	Black	H.T.W.S.
High temp. water return	Yellow	Black	H.T.W.R.
Boiler feed water	Yellow	Black	B.F.
Low temp. water supply (heating)	Yellow	Black	L.T.W.S.
Low temp. water return (heating)	Yellow	Black	L.T.W.R.
Condenser water supply	Green	White	COND. W.S.
Condenser water return	Green	White	COND. W.R.
Chilled water supply	Green	White	C.H.W.S.
Chilled water return	Green	White	C.H.W.R.
Treated water	Green	White	TR. WATER
Chemical feed	Yellow	Black	CH. FEED
Compressed air	Blue	White	COMP. AIR
Natural gas	Yellow	Black	NAT. GAS
Propane Gas	Yellow	Black	PROP. GAS
Refrigerants	Blue	White	REFRIGERANT
Fuel oil	Yellow	Black	FUEL OIL
Steam	Yellow	Black	STEAM
Condensate	Yellow	Black	CONDENSATE

TABLE I. COLOR CODES FOR MARKING PIPE (cont.)

Material	Band	Letters and Arrow*	Legend
Hydraulic fluid under 4.1 MPa (600 psi)	Green	White	HYDRAULIC FLUID-__PSI
Hydraulic fluid 4.1 MPa (600 psi) and Greater	Yellow	Black	HYDRAULIC FLUID-__PSI

TABLE II. COLOR CODE MARKING SIZES

Outside Diameter of Pipe Covering (mm)	Width of Color Band (mm)	Arrow Length x Width (mm)	Size of Legend Letters and Numerals (mm)
Less than 38	200	200 x 57	13
38 to 60	200	200 x 57	19
60 to 150	300	200 x 57	31
200 to 225	600	300 x 110	63
Over 250	800	300 x 115	88

3.11 INSPECTION AND ACCEPTANCE

In addition to meeting previously specified requirements, demonstrate mobility of moving components, including swinging and sliding doors, cabinets, and windows with operable sash, for inspection by the Contracting Officer. Perform this demonstration after appropriate curing and drying times of coatings have elapsed and prior to invoicing for final payment.

3.12 PAINT TABLES

All DFT's are minimum values.

3.12.1 EXTERIOR PAINT TABLES

DIVISION 5: EXTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

STEEL / FERROUS SURFACES

A. New Steel that has been hand or power tool cleaned to SSPC SP 2 or SSPC SP 3

1. Alkyd

New; MPI EXT 5.1Q-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 23 MPI 94 MPI 94

System DFT: 131 microns

B. New Steel that has been blast-cleaned to SSPC SP 6:

1. Alkyd

New; MPI EXT 5.1D-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 79 MPI 94 MPI 94

System DFT: 131 microns

C. Not Used

D. New steel blast cleaned to SSPC SP 10:

1. Waterborne Light Industrial
MPI EXT 5.1R-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 110-G5
System DFT: 212 microns

- E. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Enamel
MPI EXT 5.1S-G6 (Gloss)
Primer: Intermediate: Topcoat:
MPI 79 MPI 27 MPI 27 (+NSA)
System DFT: 131 microns

EXTERIOR GALVANIZED SURFACES

- F. New Galvanized surfaces:

1. MPI EXT 5.3H-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 MPI 11 MPI 11
System DFT: 112 microns

- G. Galvanized surfaces with slight coating deterioration; little or no rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3J-G5 (Semigloss)
Primer: Intermediate: Topcoat:
MPI 134 N/A MPI 110-G5
System DFT: 112 microns

- H. Galvanized surfaces with severely deteriorated coating or rusting:

1. Waterborne Light Industrial Coating
MPI REX 5.3L-G5(Semigloss)
Primer: Intermediate: Topcoat:
MPI 101 MPI 108 MPI 110-G5
System DFT: 212 microns

EXTERIOR SURFACES, OTHER METALS (NON-FERROUS)

- I. Aluminum, aluminum alloy and other miscellaneous non-ferrous metal items not otherwise specified except hot metal surfaces, roof surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd

MPI EXT 5.4F-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 94	MPI 94

System DFT: 125 microns

2. Waterborne Light Industrial Coating

MPI EXT 5.4G-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 110-G5	MPI 110-G5

System DFT: 125 microns

I. Not Used

J. Surfaces adjacent to painted surfaces; Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. Alkyd

MPI EXT 5.1D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 94	MPI 94

System DFT: 131 microns

2. Waterborne Light Industrial Coating

MPI EXT 5.1C-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 110-G5	MPI 110-G5

System DFT: 125 microns

K. Hot metal surfaces subject to temperatures up to 205 degrees C (400 degrees F):

1. Heat Resistant Enamel

MPI EXT 5.2A

Primer:	Intermediate:	Topcoat:
MPI 21	Surface preparation and number of coats per manufacturer's instructions.	

System DFT: Per Manufacturer

L. Ferrous metal subject to high temperature, up to 400 degrees C (750 degrees F):

1. Inorganic Zinc Rich Coating

MPI EXT 5.2C

Primer:	Intermediate:	Topcoat:
MPI 19	Surface preparation and number of coats per manufacturer's instructions.	

System DFT: Per Manufacturer

2. Heat Resistant Aluminum Enamel

MPI EXT 5.2B (Aluminum Finish)

Primer: Intermediate: Topcoat:

MPI 2 Surface preparation and number of coats per
manufacturer's instructions.

System DFT: Per Manufacturer

M. Not Used

DIVISION 6: EXTERIOR WOOD; DRESSED LUMBER AND PANELING PAINT TABLE

A. New Dressed lumber, Wood and plywood, trim, including top, bottom and edges of
doors not otherwise specified:

1. Alkyd

MPI EXT 6.3B-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 7 MPI 94 MPI 94

System DFT: 125 microns

2. Latex

MPI EXT 6.3A-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 7 MPI 11 MPI 11

System DFT: 125 microns

3. Waterborne Solid Color Stain

MPI EXT 6.3K

Primer: Intermediate: Topcoat:

MPI 7 MPI 16 MPI 16

System DFT: 106 microns

B. Not Used

C. Not Used

D. Not Used

E. Not Used

F. Not Used

G. Not Used

DIVISION 9: EXTERIOR STUCCO PAINT TABLE

A. New stucco:

1. Latex

New; MPI EXT 9.1A-G1 (Flat)

Primer:	Intermediate:	Topcoat:
MPI 10	MPI 10	MPI 10

System DFT: 112 microns

New; MPI EXT 9.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 11	MPI 11	MPI 11

System DFT: 112 microns

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces.

B. New stucco, elastomeric system:

1. Elastomeric Coating

New; MPI EXT 9.1C / Existing; MPI REX 9.1C

Primer:	Intermediate:	Topcoat:
N/A	MPI 113	MPI 113

System DFT: 400 microns

Primer as recommended by manufacturer. Topcoat: Coating to match adjacent surfaces. Surface preparation and # of coats in accordance with manufacturer's instructions).

NOTE: Apply sufficient coats of MPI 113 to achieve a minimum dry film thickness of 400 microns.

3.12.2 INTERIOR PAINT TABLES

DIVISION 3: INTERIOR CONCRETE PAINT TABLE

A. New Concrete, vertical surfaces, not specified otherwise:

1. Latex

New; MPI INT 3.1A-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 52	MPI 52

System DFT: 100 microns

New; MPI INT 3.1A-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 54	MPI 54

System DFT: 100 microns

2. Institutional Low Odor / Low VOC Latex

New; MPI INT 3.1M-G4 (satin)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 100 microns

New; MPI INT 3.1M-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 100 microns

B. Concrete ceilings, uncoated:

1. Latex Aggregate

MPI INT 3.1N

Primer:	Intermediate:	Topcoat:
N/A	N/A	MPI 42

System DFT: Per Manufacturer

Texture - Medium. Surface preparation, number of coats, and primer in accordance with manufacturer's instructions.
Topcoat: Coating to match adjacent surfaces.

C. New Concrete in toilets, restrooms, laundry areas, and shower areas, and other high-humidity areas not otherwise specified except floors:

1. Waterborne Light Industrial Coating

New; MPI INT 3.1L-G3(Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 110-G3	MPI 110-G3	MPI 110-G3

System DFT: 120 microns

New; MPI INT 3.1L-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 110-G5	MPI 110-G5	MPI 110-G5

System DFT: 120 microns

2. Alkyd

New; MPI INT 3.1D-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 51	MPI 51

System DFT: 112 microns

MPI INT 3.1D-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

System DFT: 112 microns

3. Epoxy

New; MPI INT 3.1F-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 77	MPI 77	MPI 77

System DFT: 100 microns

Note: Primer may be reduced for penetration per manufacturer's instructions.

D. Not Used

E. Not Used

DIVISION 4: INTERIOR CONCRETE MASONRY UNITS PAINT TABLE

A. New Concrete masonry:

1. High Performance Architectural Latex

MPI INT 4.2D-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 139	MPI 139

System DFT: 275 microns

MPI INT 4.2D-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 140	MPI 140

System DFT: 275 microns

MPI INT 4.2D-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 141	MPI 141

System DFT: 275 microns

Fill all holes in masonry surface

2. Institutional Low Odor / Low VOC Latex

New; MPI INT 4.2E-G3 (Eggshell)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 145	MPI 145

System DFT: 100 microns

New; MPI INT 4.2E-G4 (Satin)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 146	MPI 146

System DFT: 100 microns

New; MPI INT 4.2E-G5 (Semigloss)

Filler	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 147	MPI 147

System DFT: 100 microns

B. Not Used

C. New Concrete masonry units in toilets, restrooms, laundry areas, shower areas, and other high humidity areas unless otherwise specified:

1. Waterborne Light Industrial Coating

MPI INT 4.2K-G3(Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G3	MPI 110-G3
System DFT: 275 microns			

MPI INT 4.2K-G5(Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	N/A	MPI 110-G5	MPI 110-G5
System DFT: 275 microns			

Fill all holes in masonry surface

2. Alkyd

MPI INT 4.2N-G3 (Eggshell)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 51	MPI 51
System DFT: 300 microns			

MPI INT 4.2N-G5 (Semigloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 47	MPI 47
System DFT: 300 microns			

MPI INT 4.2N-G6 (Gloss)

Filler:	Primer:	Intermediate:	Topcoat:
MPI 4	MPI 50	MPI 48	MPI 48
System DFT: 300 microns			

Fill all holes in masonry surface

D. Not Used

DIVISION 5: INTERIOR METAL, FERROUS AND NON-FERROUS PAINT TABLE

INTERIOR STEEL / FERROUS SURFACES

A. Metal, Mechanical, Electrical, Fire extinguishing sprinkler systems including valves, conduit, hangers, supports, surfaces adjacent to painted surfaces (Match surrounding finish), exposed copper piping, and miscellaneous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. High Performance Architectural Latex

MPI INT 5.1R-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 139	MPI 139

System DFT: 125 microns

MPI INT 5.1R-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 141	MPI 141

System DFT: 125 microns

2. Alkyd

MPI INT 5.1E-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 51	MPI 51

System DFT: 131 microns

MPI INT 5.1E-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47

System DFT: 131 microns

B. Metal floors (non-shop-primed surfaces or non-slip deck surfaces) with non-skid additive (NSA), load at manufacturer's recommendations.:

1. Alkyd Floor Paint

MPI INT 5.1U-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 27	MPI 27 (+NSA)

System DFT: 131 microns

2. Epoxy

MPI INT 5.1L-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 101	MPI 77	MPI 77 (+NSA)

System DFT: 131 microns

C. Metal in toilets, restrooms, laundry areas, shower areas, and other high-humidity areas not otherwise specified except floors, hot metal surfaces, and new prefinished equipment:

1. Alkyd

MPI INT 5.1E-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 51	MPI 51

System DFT: 131 microns

MPI INT 5.1E-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 47	MPI 47

System DFT: 131 microns

MPI INT 5.1E-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 48	MPI 48

System DFT: 131 microns

D. Ferrous metal in concealed damp spaces or in exposed areas having unpainted adjacent surfaces as follows:

1. Aluminum Paint

MPI INT 5.1M

Primer:	Intermediate:	Topcoat:
MPI 79	MPI 1	MPI 1

System DFT: 106 microns

E. Miscellaneous non-ferrous metal items not otherwise specified except floors, hot metal surfaces, and new prefinished equipment. Match surrounding finish:

1. High Performance Architectural Latex

MPI INT 5.4F-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 140	MPI 140

System DFT: 125 microns

MPI INT 5.4F-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 141	MPI 141

System DFT: 125 microns

2. Alkyd

MPI INT 5.4J-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 47	MPI 47

System DFT: 125 microns

MPI INT 5.4J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 95	MPI 48	MPI 48

System DFT: 125 microns

F. Hot metal surfaces subject to temperatures up to 205 degrees C (400 degrees F):

1. Heat Resistant Enamel

MPI INT 5.2A

Primer:	Intermediate:	Topcoat:
MPI 21	Surface preparation and number of coats per manufacturer's instructions.	

System DFT: Per Manufacturer

G. Not Used

H. Not Used

DIVISION 6: INTERIOR WOOD PAINT TABLE

A. New Wood and plywood not otherwise specified:

1. High Performance Architectural Latex

MPI INT 6.4S-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 139	MPI 139

System DFT: 112 microns

MPI INT 6.4S-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 140	MPI 140

System DFT: 112 microns

2. Alkyd

MPI INT 6.4B-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 51	MPI 51

System DFT: 112 microns

3. Institutional Low Odor / Low VOC Latex

New; MPI INT 6.3V-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 145	MPI 145

System DFT: 100 microns

New; MPI INT 6.3V-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 39	MPI 146	MPI 146

System DFT: 100 microns

B. Not Used

C. New Wood and Plywood, except floors; natural finish or stained:

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.4J-G4

Primer:	Intermediate:	Topcoat:
MPI 57	MPI 57	MPI 57

System DFT: 100 microns

New; MPI INT 6.4J-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 56	MPI 56	MPI 56

System DFT: 100 microns

2. Stained, oil-modified polyurethane

New; MPI INT 6.4E-G4

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 57	MPI 57	MPI 57
System DFT: 100 microns			

New; MPI INT 6.4E-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 56	MPI 56	MPI 56
System DFT: 100 microns			

3. Stained, Moisture Cured Urethane

New; MPI INT 6.4V-G2 (Flat)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 71	MPI 71	MPI 71
System DFT: 100 microns			

New; MPI INT 6.4V-G6 (Gloss)

Stain:	Primer:	Intermediate:	Topcoat:
MPI 90	MPI 31	MPI 31	MPI 31
System DFT: 100 microns			

D. Not used

E. Not Used

F. New wood surfaces in toilets, restrooms, laundry areas, shower areas, and other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial

MPI INT 6.3P-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G5	MPI 110-G5
System DFT: 112 microns		

MPI INT 6.3P-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 110-G6	MPI 110-G6
System DFT: 112 microns		

3. Alkyd

MPI INT 6.3B-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 47	MPI 47
System DFT: 112 microns		

MPI INT 6.3B-G6 (Gloss)

Primer:	Intermediate:	Topcoat:
MPI 45	MPI 48	MPI 48
System DFT: 112 microns		

G. Not Used

H. New Wood Doors; Natural Finish or Stained (not factory finished):

1. Natural finish, oil-modified polyurethane

New; MPI INT 6.3K-G4

Primer: Intermediate: Topcoat:

MPI 57 MPI 57 MPI 57

System DFT: 100 microns

New; MPI INT 6.3K-G6 (Gloss)

Primer: Intermediate: Topcoat:

MPI 56 MPI 56 MPI 56

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

2. Stained, oil-modified polyurethane

New; MPI INT 6.3E-G4

Stain: Primer: Intermediate: Topcoat:

MPI 90 MPI 57 MPI 57 MPI 57

System DFT: 100 microns

New; MPI INT 6.3E-G6 (Gloss)

Stain: Primer: Intermediate: Topcoat:

MPI 90 MPI 56 MPI 56 MPI 56

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

3. Stained, Moisture Cured Urethane

New; MPI INT 6.4V-G6 (Gloss)

Stain: Primer: Intermediate: Topcoat:

MPI 90 MPI 31 MPI 31 MPI 31

System DFT: 100 microns

Note: Sand between all coats per manufacturers recommendations.

I. New Wood Doors; Pigmented finish:

1. Alkyd

New; MPI INT 6.3B-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 45 MPI 47 MPI 47

System DFT: 112 microns

New; MPI INT 6.3B-G6 (Gloss)

Primer: Intermediate: Topcoat:

MPI 45 MPI 48 MPI 48

System DFT: 112 microns

Note: Sand between all coats per manufacturers recommendations.

2. Pigmented Polyurethane

New; MPI INT 6.1E-G6 (Gloss)

Primer: Intermediate: Topcoat:

MPI 72 MPI 72 MPI 72

System DFT: 112 microns

Note: Sand between all coats per manufacturers recommendations.

J. Not Used

1. Alkyd

New; MPI RIN 6.3B-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 46 MPI 47 MPI 47

System DFT: 112 microns

New; MPI RIN 6.3B-G6 (Gloss)

Primer: Intermediate: Topcoat:

MPI 46 MPI 48 MPI 48

System DFT: 112 microns

Note: Sand between all coats per manufacturers recommendations.

DIVISION 9: INTERIOR PLASTER AND GYPSUM BOARD, PAINT TABLE

A. New Plaster and Gypsum Wallboard not otherwise specified:

1. Latex

New; MPI INT 9.2A-G3 (Eggshell)

Primer: Intermediate: Topcoat:

MPI 50 MPI 52 MPI 52

System DFT: 100 microns

New; MPI INT 9.2A-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 50 MPI 54 MPI 54

System DFT: 100 microns

2. High Performance Architectural Latex - High Traffic Areas

New; MPI INT 9.2B-G3 (Eggshell)

Primer: Intermediate: Topcoat:

MPI 50 MPI 139 MPI 139

System DFT: 100 microns

New; MPI INT 9.2B-G5 (Semigloss)

Primer: Intermediate: Topcoat:

MPI 50 MPI 141 MPI 141

System DFT: 100 microns

3. Institutional Low Odor / Low VOC Latex

New; MPI INT 9.2M-G3 (Eggshell)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 145	MPI 145

System DFT: 100 microns

New; MPI INT 9.2M-G4 (Satin)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 146	MPI 146

System DFT: 100 microns

New; MPI INT 9.2M-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 147	MPI 147

System DFT: 100 microns

B. New Plaster and Wallboard in toilets, restrooms, laundry areas, shower areas, and other high humidity areas not otherwise specified.:

1. Waterborne Light Industrial Coating

New; MPI INT 9.2L-G5(Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 110-G5	MPI 110-G5

System DFT: 100 microns

2. Alkyd

New; MPI INT 9.2C-G5 (Semigloss)

Primer:	Intermediate:	Topcoat:
MPI 50	MPI 47	MPI 47

System DFT: 100 microns

-- End of Section --

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SECTION 10160
TOILET PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-60003 Partitions, Toilet, Complete

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; GA

Drawings showing plans, elevations, details of construction, hardware, reinforcing, fittings, mountings, and anchorings.

SD-03 Product Data

Toilet Partition System;

Manufacturer's technical data and catalog cuts including installation and cleaning instructions.

SD-04 Samples

Toilet Partition System; GA

Manufacturer's standard color charts and color samples.

1.3 SYSTEM DESCRIPTION

Toilet partition system, including toilet enclosures, room entrance screens, and urinal screens, shall be a complete and usable system of panels, hardware, and support components. The partition system shall be provided by a single manufacturer and shall be a standard product as shown in the most recent catalog data. The partition system shall be as shown on the approved detail drawings.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the job site in the manufacturer's original packaging with the brand, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated; free from dust, water, or other contaminants; and shall have easy access for inspection and handling.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

PART 2 PRODUCTS

2.1 TOILET ENCLOSURES

Toilet enclosures shall conform to CID A-A-60003, Type I, Style C, overhead braced. Width, length, and height of toilet enclosures shall be as shown. Finish surface of panels shall be high density polyethylene (HDPE). Panels indicated to receive toilet paper holders or grab bars as specified in SECTION: TOILET ACCESSORIES, shall be prepared for mounting of the items required. Grab bars shall withstand a bending stress, shear stress, shear force, and a tensile force induced by 1112 N (250 lbf). Grab bars shall not rotate within their fittings.

2.2 URINAL SCREENS

Urinal screens shall conform to CID A-A-60003, Type III, Style A, floor supported. Finish surface of screens shall be laminated plastic, Finish 3. Width and height of urinal screens shall be as shown.

2.3 HARDWARE

Hardware for the toilet partition system shall conform to CID A-A-60003 for the specified type and style of partitions. Wall brackets and headrails shall be aluminum. Shoes, hinges, door latch/strike and other components shall be stainless steel. All fasteners shall be stainless steel. Hardware finish shall be highly resistant to alkalis, urine, and other common toilet room acids.

2.4 COLORS

Color of finishes for toilet partition system components shall be manufacturer's standard as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet partitions shall be installed straight and plumb in accordance with approved manufacturer's instructions with horizontal lines level and rigidly anchored to the supporting construction. Where indicated, anchorage to walls shall be by toggle-bolting. Where partitions are anchored to stud walls, continuous, 5 mm thick, steel plate blocking shall be rigidly attached to studs and concealed within the wall along the entire partition contact area.

Drilling and cutting for installation of anchors shall be at locations that will be concealed in the finished work.

3.2 ADJUSTING AND CLEANING

Doors shall have a uniform vertical edge clearance of approximately 5 mm and shall rest open at approximately 30 degrees when unlatched. Toilet partitions shall be cleaned in accordance with approved manufacturer's instructions and shall be protected from damage until accepted.

END OF SECTION

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SECTION 10200

LOUVERS AND VENTS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ARCHITECTURAL MANUFACTURER'S ASSOCIATION (AAMA)

AAMA 603.8 (1992; ADDENDUM 1993) Pigmented Organic Coatings on Extruded Aluminum

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500 (1991) Louvers, Dampers and Shutters

AMCA 511 (1986) Certified Ratings Program for Air Control Devices

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 653/A 653M (1995) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 209 (1995) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 221 (1995) Aluminum and Aluminum-alloy Extruded Bars, Rods, Wire, Shapes and Tubes

SHEET METAL AND AIR CONDITIONING CONTRACTORS NATIONAL ASSOCIATION, INC. (SMACNA)

SMACNA Arch. Manual (1993; Errata; Addenda Oct 1997) Architectural Sheet Metal Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Louvers and Vents; G, A/S
Finishes; G, A/S
Accessory Items; G, A/S

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of louver and vent, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Shop Drawings

Louvers and Vents; G, A/S

Shop drawings shall indicate assemblies that are not completely shown by product data. Indicate all information required for fabrication and installation, including material, size, thickness, fastenings and profiles. Identify electrical/mechanical devices for all operable devices. Indicate location and size of ductwork adjacent or attached to louvers and vents.

1.3 DELIVERY, STORAGE, AND HANDLING

Deliver materials to the site in an undamaged condition. Carefully store materials off the ground to provide proper ventilation, drainage, and protection against dampness. Louvers shall be free from nicks, scratches, and blemishes. Replace defective or damaged materials with new.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of louvers and vents with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Installation provides a weathertight opening.
- (5) All finishes and colors are as indicated.
- (6) Installed materials are protected from damage.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Galvanized Steel Sheet

ASTM A653, coating designation Z 275 G 90.

2.1.2 Aluminum Sheet

ASTM B 209M/B 209, alloy 3003 or 5005 with temper as required for forming.

2.1.3 Extruded Aluminum

ASTM B 221, alloy 6063-T5 or T-52.

2.1.4 Fastenings

Use same material as items fabricated, or stainless steel. Provide types, gages and lengths to suit installation conditions. Use socket flathead machine screws for exposed fasteners, not pop rivets.

2.1.5 Anchors and Inserts

Use non-ferrous metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance.

2.1.6 Primer and Repair Paints

Metal primer paint for galvanized steel surfaces shall be Rustoleum "Galvinoleum" or other paint standard with the louver manufacturer. Galvanizing repair paint shall be zinc dust type, Rodda No. 23710 "Zinc Coat" or equal.

2.2 LOUVERS

Louvers shall be weather resistant type equipped with "storm" profile head channel and blades incorporating drain gutters and vertical downspouts to limit water penetration and efficiently drain water out at a sloped lower sill. Louvers shall be designed to withstand a minimum wind load of 146 k/sq. meter. Blades shall be positioned at 35 to 45 degree angle at nominal 150 mm on center. Wall louvers shall bear the AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500 and AMCA 511. The rating shall show the beginning point of water penetration at 366 meters per minute free area velocity. To the maximum extent possible, louvers and vents shall be a manufacturer's standard product.

2.2.1 Extruded Aluminum Louvers

Fabricated of extruded 6063-T5 or -T52 aluminum with a wall and blade thickness of not less than 2 mm; 150 mm louver depth; 45 percent minimum free area. All louvers connected to ductwork of mechanical systems shall be of this type.

2.2.2 Formed Metal Louvers

Formed of zinc-coated steel sheet not thinner than 16 U.S. gauge, or aluminum sheet not less than 2 mm thick, 100 mm louver depth; 50 percent minimum free area.

2.2.3 Mullions

Shall be same material and finish as louvers. Provide concealed interior mullions for all louvers more than 1500 mm in width at not more than 1500 mm on center.

2.2.4 Screens

For all aluminum louvers, provide 19 mm square mesh, 14 or 16 gauge aluminum bird screening. For steel louvers, provide 12 mm square mesh, 16 gauge copper; or 6 mm square mesh, 16 gauge zinc-coated steel or copper bird screening. Mount screens in removable, repairable frames of same material and finish as the louvers. Screens shall be mounted on inside face of louver.

2.3 FINISHES

2.3.1 Aluminum Louvers (In Door Frames)

Provide factory applied organic coating. Clean and prime exposed aluminum surfaces and apply a baked enamel finish conforming to AAMA 603.8, 0.8 mil minimum dry film thickness, color to match door frame in which louver is installed.

2.3.2 Steel or Aluminum Wall Louvers

Provide factory-applied primer. Clean and phosphate treat exposed surfaces and apply rust-inhibitive primer. Field paint in accordance with SECTION: PAINTING, GENERAL. Color as indicated on drawings.

2.3.3 Protection of Dissimilar Materials

Where aluminum contacts metal other than zinc, paint the dissimilar metal with a primer and two coats of aluminum paint. Paint metal in contact with mortar, concrete or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 General

Install using stops or moldings, flanges, strap anchors, or jamb fasteners as appropriate for the wall construction and in accordance with manufacturer's recommendations. Locate and place louvers plumb, level and in proper alignment with adjacent work.

3.1.2 Fastening and Sealing

Use concealed anchorages wherever possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection. Form tight joints with exposed connections accurately fit together. Provide reveals and openings for sealants and joint fillers. Provide concealed gaskets flashing and joint fillers. Install as the work progresses to make the installation weathertight.

3.1.3 Bird Screens

Attach screen frames to louvers with screws or bolts. Screens shall be installed on the interior face of all louvers.

3.1.4 Repairs

Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes and prime coat of paint so that there is not evidence of corrective work. Return items that cannot be refinished in the field to the shop to make the required alterations and refinish the entire unit.

3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

END OF SECTION

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SECTION 10260

WALL AND CORNER PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

ASTM D 256 (1997) Determining the IZOD Pendulum Impact Resistance of Plastics

ASTM D 635 (1998) Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position

ASTM E 84 (1999e1) Surface Burning Characteristics of Building Materials

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Manual (1988) Metal Finishes Manual for Architectural and Metal Products

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 80 (1999) Fire Doors and Fire Windows

SOCIETY OF AMERICAN AUTOMOTIVE ENGINEERS (SAE)

SAE J1545 (1986) Instrumental Color Difference Measurement for Exterior Finishes, Textiles and Color Trim

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Corner Guards; G
Wall Guards (Bumper Guards); G
Door Protectors; G
Wall Covering/Panels; G

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

Corner Guards; G
Wall Guards (Bumper Guards); G
Door Protectors; G
Wall Covering/Panels; G

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-04 Samples

Finish; G

Manufacturer's standard samples indicating color and texture of materials requiring color and finish selection.

SD-07 Certificates

Corner Guards; G
Wall Guards (Bumper Guards); G
Door Protectors; G
Wall Covering/Panels; G

Statements attesting that the items comply with specified fire and safety code requirements.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover. Materials shall be stored at approximately 21 degrees C for at least 48 hours prior to installation.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of wall and corner protection with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL

To the maximum extent possible, corner guards, wall panels and wall covering shall be the standard products of a single manufacturer and shall be furnished as detailed. Drawings show general configuration of products required, and items differing in minor details from those shown will be acceptable.

2.1.1 Resilient Material

Resilient material shall consist of high impact resistant extruded acrylic vinyl, polyvinyl chloride, or injection molded thermal plastic and shall conform to the following:

2.1.1.1 Minimum Impact Resistance

Minimum impact resistance shall be 960.8 nm/m (18 ft. lb/sq. inch) when tested in accordance with ASTM D 256, (Izod impact, ft. lbs per sq inch notched).

2.1.1.2 Fire Rating

Fire rating shall be Class 1 when tested in accordance with ASTM E 84, having a maximum flame spread of 25 and a smoke developed rating of 450 or less. Material shall be rated self extinguishing when tested in accordance with ASTM D 635. Material shall be labeled and tested by an approved nationally known testing laboratory. Resilient material used for protection on fire rated doors and frames shall be listed by the testing laboratory performing the tests. Resilient material installed on fire rated wood/steel door and frame assemblies

shall have been tested on similar type assemblies. Test results of material tested on any other combination of door/frame assembly will not be acceptable.

2.1.1.3 Integral Color

Colored components shall have integral color and shall be matched in accordance with SAE J1545 to within plus or minus 1.0 on the CIE-LCH scales.

2.2 CORNER GUARDS

2.2.1 Resilient Corner Guards

Corner guard units shall be surface mounted type, radius formed to profile shown. Corner guards shall be 1200 mm high or as indicated. Mounting hardware, cushions, and base plates shall be furnished. Assembly shall consist of a snap-on corner guard formed from high impact resistant resilient material, minimum 1.98 mm thick, mounted on a continuous aluminum retainer. Extruded aluminum retainer shall conform to ASTM B 221, alloy 6063, temper T5 or T6. Flush mounted type guards shall act as a stop for adjacent wall finish material. Factory fabricated end closure caps shall be furnished for top and bottom of surface mounted corner guards. Flush mounted corner guards installed in fire rated wall shall maintain the rating of the wall. Insulating materials that are an integral part of the corner guard system shall be provided by the manufacturer of the corner guard system. Exposed metal portions of fire rated assemblies shall have a paintable surface.

2.2.2 Stainless Steel Corner Guards

Stainless steel corner guards shall be fabricated of 1.58 mm thick material conforming to ASTM A 167, type 302 or 304. Corner guards shall extend from floor to ceiling. shall be 1200 mm high, or as indicated. Corner guard shall be formed to dimensions shown.

2.3 WALL COVERING/PANELS

Wall covering/panels shall consist of high impact rigid acrylic vinyl or polyvinyl chloride resilient material. Panel sizes shall be 0.61 x 1.20 mm or as indicated. Wall covering thickness for rigid acrylic vinyl shall be 1.02 mm (0.040 inch).

2.4 TRIM, FASTENERS AND ANCHORS

Vinyl trim, fasteners and anchors shall be provided for each specific installation as shown.

2.5 FINISH

2.5.1 Aluminum Finish

Finish for aluminum shall be in accordance with AA DAF-45. Exposed aluminum shall be designation AA-C22A31 chemically etched medium matte, with clear anodic coating class II architectural coating 0.010 mm (0.4 mil) thick. Concealed aluminum shall be mill finish.

2.5.2 Stainless Steel Finish

Finish for stainless steel shall be in accordance with NAAMM AMP 500 Manual, finish number 4.

2.6 COLOR

Color shall be as indicated on drawings.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Corner Guards and Wall Guards (Bumper Guards)

Material shall be mounted at location indicated in accordance with manufacturer's recommendations.

3.1.2 Door, Door Frame Protectors, and Wall Panels

Surfaces to receive protection shall be clean, smooth, and free of obstructions. Protectors shall be installed after frames are in place, but prior to hanging of doors, in accordance with manufacturer's specific instructions. Adhesives shall be applied in controlled environment in accordance with manufacturer's recommendations. Protection for fire doors and frames shall be installed in accordance with NFPA 80.

END OF SECTION

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SECTION 10430
EXTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1 (1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M (1997ael) Carbon Structural Steel

ASTM A 123/A 123M (1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

ASTM A 570/A 570M (1998) Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality

ASTM A 653/A 653M (1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM A 924/A 924M (1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

ASTM B 26/B 26M (1999) Aluminum-Alloy Sand Castings

ASTM B 62 (1993) Composition Bronze or Ounce Metal Castings

ASTM B 108 (1999) Aluminum-Alloy Permanent Mold Castings

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM B 209M (1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)

ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C 1036	(1991; R 1997) Flat Glass
ASTM D 3841	(1997) Glass-Fiber-Reinforced Polyester Plastic Panels
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

AMERICAN WELDING SOCIETY (AWS)

AWS C1.1	(1966) Recommended Practices for Resistance Welding
AWS D1.1	(2000) Structural Welding Code - Steel
AWS D1.2	(1997) Structural Welding Code - Aluminum

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 505	(1988) Metal Finishes Manual for Architectural and Metal Products; Section: Applied Coatings
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
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SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE AMS 3611	(1994; Rev D) Plastic Sheet, Polycarbonate General Purpose
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1.2 GENERAL

All exterior signage shall be provided by a single manufacturer. Exterior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3 WIND LOAD REQUIREMENTS

Exterior signage shall be designed to withstand the windload resulting from the design windspeed of 38 meters per second.

1.4 CHARACTER PROPORTIONS AND HEIGHTS

Letters and numbers on indicated signs for handicapped-accessible buildings shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

Drawings showing elevations of each type of sign; dimensions, details, and methods of mounting or anchoring; shape and thickness of materials; and details of construction. A schedule showing the location, each sign type, and message shall be included.

SD-03 Product Data

Modular Exterior Signage System; G

Manufacturer's descriptive data and catalog cuts.

Installation;

Manufacturer's installation instructions and cleaning instructions.

Exterior Signs; G

Exterior signage schedule in electronic media with spread sheet format. Spread sheet shall include sign location, sign type, and message.

Wind Load Requirements;

Design analysis and supporting calculations performed in support of specified signage.

SD-04 Samples

Exterior Signs; G

One sample of each type of sign. Each sample shall consist of a complete sign panel with letters and symbols. Samples may be installed in the work, provided each sample is identified and location recorded. Two samples of manufacturer's

standard color chips for each material requiring color selection and 305 mm 12 inch square sample of sign face color sample.

1.6 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of the products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.7 DELIVERY AND STORAGE

Materials shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area in accordance with manufacturer's instructions.

1.8 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a one year period shall be provided.

1.9 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of exterior signage with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Signage is protected until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MODULAR EXTERIOR SIGNAGE SYSTEM

Exterior signage shall consist of a system of coordinated directional, identification, and regulatory type signs located where shown. Dimensions, details, materials, message content, and design of signage shall be as shown.

2.1.1 Free-Standing Base Mount Pylon/Monolith Type Signs

2.1.1.1 Framing

Interior framing shall consist of aluminum or galvanized steel tube columns welded to companion plates. Perimeter framing shall consist of aluminum or steel angle framing welded

to the post and plate system as designed. Framing members shall be designed to permit access to electrical equipment and panel removal. Mounting shall be provided as shown. Framing members of steel shall be finished with semi-gloss baked enamel or two-component acrylic polyurethane. Openings shall be sealed from moisture and made tamper-proof.

2.1.1.2 Exterior Sheeting Panels

Modular panels shall be provided in sizes shown on drawings. Panels shall be fabricated a minimum of 2.3 mm thick aluminum. Panels shall be heliarc welded to framing system. Top and end panels shall be removable and shall be secured by 5 mm socket head jack nuts. Finish for metal panels shall be anodized conforming to AA DAF-45.

2.1.1.3 Mounting

Mounting shall be provided by securing to concrete foundation as shown.

2.1.1.4 Finishes

Base finish shall be anodized conforming to AA DAF-45. Metal panel system finish shall be anodized conforming to AA DAF-45.

2.2 GRAPHICS FOR EXTERIOR SIGNAGE SYSTEMS

2.2.1 Graphics

Signage graphics shall conform to the following:

Message shall be applied to panel using the silkscreen process. Silkscreened images shall be executed with photo screens prepared from original art. Handcut screens will not be accepted. Original art shall be defined as artwork that is a first generation pattern of the original specified art. Edges and corners shall be clean. Rounded corners, cut or ragged edges, edge buildup, bleeding or surfaces pinholes will not be accepted.

2.2.2 Messages

See drawings and schedule for message content. Typeface: Helvetica medium. Type size as indicated.

2.3 BUILDING NUMBER SIGNS

2.3.1 Fabrication

Building number signs shall have black vinyl letters on a white reflective vinyl background mounted on 28 gauge galvanized steel.

2.3.2 Typeface

Typeface shall be helvetica medium, size as indicated.

2.3.3 Mounting

Threaded studs of number and size as recommended by manufacturer, shall be used for concealed anchorage.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum alloy products shall conform to ASTM B 209M ASTM B 209 for sheet or plate, ASTM B 221M ASTM B 221 for extrusions and ASTM B 26/B 26M or ASTM B 108 for castings. Aluminum extrusions shall be provided at least 3 mm thick and aluminum plate or sheet at least 16 gauge thick. Welding for aluminum products shall conform to AWS C1.1.

2.5 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Integrated color anodized designation AA-M10-C22-A32, Architectural Class 0.010 to 0.018 mm.

2.6 STEEL PRODUCTS

Structural steel products shall conform to ASTM A 36/A 36M. Sheet and strip steel products shall conform to ASTM A 570/A 570M. Welding for steel products shall conform to AWS D1.2.

2.7 VINYL SHEETING FOR GRAPHICS

Vinyl sheeting shall be 5 to 7 year premium type and shall be in accordance with the flammability requirements of ASTM E 84 and shall be a minimum 0.08 mm 0.003 inch film thickness. Film shall include a precoated pressure sensitive adhesive backing, Class 1, or positionable pressure sensitive adhesive backing, Class 3.

2.8 ANCHORS AND FASTENERS

Exposed anchor and fastener materials shall be compatible with metal to which applied and shall match in color and finish and shall be non-rusting, non-corroding, and non-staining. Exposed fasteners shall be tamper-proof.

2.9 SHOP FABRICATION AND MANUFACTURE

2.9.1 Factory Workmanship

Work shall be assembled in the shop, as far as practical, ready for installation at the site. Work that cannot be shop assembled shall be given a trial fit in the shop to ensure proper field assembly. Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Welding to or on structural steel shall be in accordance with AWS D1.1. Welding shall be continuous along the entire area of contact. Exposed welds shall be ground smooth. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practical. Items specified to be galvanized shall be by hot-dip process after fabrication if practical. Galvanization shall be in accordance with ASTM A 123/A 123M and ASTM A 653/A 653M, as

applicable. Other metallic coatings of steel sheet shall be in accordance with ASTM A 924/A 924M. Joints exposed to the weather shall be formed to exclude water. Drainage and weep holes shall be included as required to prevent condensation buildup.

2.9.2 Dissimilar Materials

Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of asphalt varnish or a coat of zinc-molybdate primer to prevent galvanic or corrosive action.

2.9.3 Shop Painting

Surfaces of miscellaneous metal work, except nonferrous metal, corrosion resisting steel, and zinc-coated work, shall be given one coat of zinc-molybdate primer or an approved rust-resisting treatment and metallic primer in accordance with manufacturer's standard practice. Surfaces of items to be embedded in concrete shall not be painted. Upon completion of work, damaged surfaces shall be recoated.

2.10 COLOR, FINISH, AND CONTRAST

Color of products shall be as indicated. Characters and symbols shall contrast with their background light characters on a dark background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs, shall be installed in accordance with approved manufacturer's instructions at locations shown on the approved detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Signs mounted on other surfaces shall not be installed until finishes on such surfaces have been completed.

3.1.1 Anchorage

Anchorage and fastener materials shall be in accordance with approved manufacturer's instructions for the indicated substrate. Anchorage not otherwise specified or indicated shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware shall be adjusted for proper operation. Frames and other sign surfaces shall be cleaned in accordance with manufacturer's instructions. After signs are completed and inspected, the Contractor shall cover all project identification, directional, and other signs which may mislead the public. Covering shall be maintained until instructed to be removed by the Contracting Officer or until the facility is to be opened for business. Signs shall be cleaned, as required, at time of cover removal.

3.2 FIELD PAINTED FINISH

Miscellaneous metals and frames shall be field painted in accordance with SECTION: PAINTING, GENERAL. Anodized metals, masonry, and glass shall be protected from paint. Finish shall be free of scratches or other blemishes.

END OF SECTION

SECTION 10440

INTERIOR SIGNAGE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45	(1997) Designation System for Aluminum Finishes
AA PK-1	(1999) Registration Record of Aluminum Association Alloy Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot

AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION (AAMA)

AAMA 605	(1998) Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z97.1	(1984; Rev 1994) Safety Performance Specifications and Methods of Test for Safety Glazing Materials Used in Buildings
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(1995) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM B 221	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B 221M	(1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric)
ASTM C 1036	(1991; R 1997) Flat Glass

AMERICAN WELDING SOCIETY (AWS)

AWS D1.2	(1997) Structural Welding Code - Aluminum
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70

(1999) National Electrical Code

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Detail Drawings; "G", "A/S"

Drawings showing elevations of each type of sign, dimensions, details and methods of mounting or anchoring, shape and thickness of materials, and details of construction. A schedule showing the location, each sign type, and message shall be included. Provide elevation of each directory signs required with actual text and graphics required.

SD-03 Product Data

Installation; "G", "A/S"

Manufacturer's descriptive data, catalogs cuts, installation and cleaning instructions.

SD-04 Samples

Interior Signage; "G", "A/S"

One sample of each of the following sign types showing typical quality and workmanship. The samples may be installed in the work, provided each sample is identified and location recorded.

- a. Directional sign.
- b. Room name/number sign.
- c. Occupant identification sign (removable message strips).

Two samples of manufacturer's standard color chips for each material requiring color selection.

SD-10 Operation and Maintenance Data

Approved Manufacturer's Instructions;
Protection and Cleaning;

1.3 GENERAL

Interior signage shall be of the design, detail, sizes, types, and message content shown on the drawings, shall conform to the requirements specified, and shall be provided at the locations indicated. Signs shall be complete with lettering, framing as detailed, and related components for a complete installation.

1.3.1 Character Proportions and Heights

Letters and numbers on indicated signs, which do not designate permanent rooms or spaces, shall have a width-to-height ratio between 3:5 and 1:1 and a stroke-width-to-height ratio between 1:5 and 1:10. Characters and numbers on indicated signs shall be sized according to the viewing distance from which they are to be read. The minimum height is measured using an upper case letter "X". Lower case characters are permitted. Suspended or projected overhead signs shall have a minimum character height of 75 mm.

1.3.2 Raised and Braille Characters and Pictorial Symbol Signs (Pictograms)

Letters and numbers on indicated signs which designate permanent rooms and spaces shall be raised 0.8 mm upper case, sans serif or simple serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be at least 16 mm in height, but no higher than 50 mm. Pictograms shall be accompanied by the equivalent verbal description placed directly below the pictogram. The border dimension of the pictogram shall be 152 mm minimum in height. Indicated accessible facilities shall use the international symbol of accessibility. Tactile graphics are required on all signs for permanent rooms and spaces, occupied and non-occupied, including service spaces, stairs and elevators. Individually applied characters are prohibited.

1.4 QUALIFICATIONS

Signs, plaques, and dimensional letters shall be the standard product of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate signs that have been in satisfactory use at least 2 years prior to bid opening.

1.5 DELIVERY AND STORAGE

Materials shall be delivered to the jobsite in manufacturer's original packaging and stored together in a clean, dry area in accordance with manufacturer's instructions until the time of installation.

1.6 EXTRA STOCK

The Contractor shall provide 20 extra frames and extra stocks (blank) of all signs noting non-permanent occupants.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of interior signage with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Conduct pre-manufacturing conference to review shop drawings and samples with government and user.
- (3) Inspection of material delivered to the project site against approved material data.
- (4) Protection of signage until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 ROOM, OCCUPANT AND DIRECTIONAL SIGNAGE SYSTEM

Signs shall be fabricated of Type ES/MP laminated thermosetting plastic suitable for engraving and/or raised letters/tactile graphics as indicated. Signs shall be of a modular type signage system providing a consistent design throughout all facilities.

2.1.1 Room Name and Number Signs

Signs shall consist of matte finish laminated thermosetting Type MP plastic. Frames shall be molded acrylic. Text and symbols shall be raised and Braille shall be included. Corners of signs shall be radiused; see drawing.

2.1.2 Occupant Identification Message Strip Signs

Changeable message strip signs shall consist of laminated thermosetting Type MP plastic with Type ES plastic captive message slider sign face with message slots and associated end caps, as detailed, for insertion of changeable message strips. Size of signs shall be as shown on the drawings. Individual 1.5 mm thick message strips to permit removal, change, and reinsertion shall be provided as detailed. Corners of signs shall be squared, see drawing. Occupant signs shall typically be located at administrative offices and barracks room modules.

2.1.3 Directional Signs

Directional signs shall match materials, graphic style and colors used for Room Name signs. Raised characters and Braille are not required.

2.1.4 Type of Mounting For Signs

Extruded aluminum brackets, mounted as shown, shall be furnished for hanging, projecting, and double-sided signs. Mounting for framed, hanging, and projecting signs shall be by mechanical fasteners through brackets. Surface mounted signs shall be permanently mounted with manufacturer's recommended two sided tape, adhesive or concealed mechanical fastener appropriate to the substrate. Two-sided tape shall not be used to attach signage at barracks room modules.

2.1.5 Graphics

See drawings for representative text and graphics.

2.2 BUILDING DIRECTORIES

Building directories shall be lobby directories or floor directories, and shall be provided with a changeable directory listing consisting of the areas, offices and personnel located within the facility. Directories shall also integrate a panel containing a graphic representation of the building floor plan(s). Dimensions, details, and materials of sign shall be as shown on the drawings. Where required, message content shall be as shown on drawings and schedule.

2.2.1 Doors

2.2.1.1 Door Glazing

Door glazing shall be a clear polycarbonate sheet 6 mm thick.

2.2.1.2 Door Construction

Extruded aluminum door frame shall be of same finish as surrounding frame. Corners shall be mitered, welded, and assembled with concealed fasteners. Hinges shall be full length piano hinges, in finish to match frames and trim. Glazing shall be set in frame with resilient glazing channels.

2.2.1.3 Door Locks

Door locks shall be manufacturer's standard, and shall be keyed alike.

2.2.2 Fabrication

BARRACKS: One piece seamless fiber reinforced polyester frame housing with structural reinforcement to prevent racking or misalignment of the frame. Extruded aluminum trim extrusion shall be assembled with corners reinforced and mitered to a hairline fit, with no exposed fasteners.

BATTALION AND COMPANY BUILDINGS: Extruded aluminum frames and trim shall be assembled with hairline fit corners and joints. Removable changeable directory panel shall consist of plywood back with workboard covering backgrooved 6mm on centers to receive flanged letters.

2.2.3 Changeable Letter/Message Strip Directory System

Directory shall consist of a non-illuminated unit with step or groove, laser or rotary engraved removable name strips. Design of unit shall be as shown in the drawings.

2.2.4 Construction

BARRACKS AND SCB: The directory shall be nominal 50 mm deep and 700 mm high. Length sized as required by content. Unit shall be surface mounted. Unit shall have a 75 mm

high header with lettering as shown. Unit shall have a tamper resistant lift off face frame with clear acrylic plastic cover.

BATTALION AND COMPANY BUILDINGS: The directory dimensions shall be as indicated on the drawings. Unit shall be surface mounted. Unit shall have a door as specified.

2.2.5 Message Strips

Room number and name strips shall be up-datable by user with coupon book reordering and with 5 to 7 day delivery. Name strips shall be acrylic sized per manufacturer's standard module, nominally 13 mm. Name strips shall be molded plastic ready for insertion in permanent channels on directory. Text shall be upper and lower case Helvetica Medium letters. Provide sufficient text and blank strips to completely fill the directory.

2.3 Touchscreen Electronic Directory System (Barracks only)

Touch screen electronic directory system shall be a complete turnkey system consisting of touch screen monitor, processor, update terminal with software connected through a local area network (LAN). The system shall be in compliance with the layout and number shown. Electrical equipment shall be UL listed and shall comply with NFPA 70.

2.3.1 Directory Unit

Directory unit shall consist of 1, 400 mm touch screen monitor and membrane keypad with alphanumeric 38 keys. Screen resolution shall be SVGA 1280 x 1024. Monitor shall be full color. Processor shall be Pentium 75 or better with sound peripherals and have a listing capacity of 96,000 items. Directory unit shall be of design and finishes as shown.

2.3.2 Update Terminal

Update terminal unit shall consist of a 300 mm color monitor with 101 key keypad. Unit shall have a 132 column report printer. Unit shall include a Pentium 75 or better PC processor with floppy disk from update terminal to each directory. System shall include network from update to each directory. Communications shall be over a telephone network or a LAN.

2.4 ALUMINUM ALLOY PRODUCTS

Aluminum extrusions shall be at least 3 mm thick, and aluminum plate or sheet shall be at least 1.3 mm thick. Extrusions shall conform to ASTM B 221M ASTM B 221; plate and sheet shall conform to ASTM B 209M ASTM B 209. Where anodic coatings are specified, alloy shall conform to AA PK-1 alloy designation 514.0. Exposed anodized aluminum finishes shall be as shown. Welding for aluminum products shall conform to AWS D1.2.

2.5 ANODIC COATING

Anodized finish shall conform to AA DAF-45 as follows:

Clear (natural) designation AA-M10-C22-A31, Architectural Class II 0.010 mm (0.4 mil) or thicker.

2.6 ORGANIC COATING

Organic coating shall conform to AAMA 605, with total dry film thickness not less than 0.030 mm.

2.7 FABRICATION AND MANUFACTURE

2.7.1 Factory Workmanship

Holes for bolts and screws shall be drilled or punched. Drilling and punching shall produce clean, true lines and surfaces. Exposed surfaces of work shall have a smooth finish and exposed riveting shall be flush. Fastenings shall be concealed where practicable.

2.7.2 Dissimilar Materials

Where dissimilar metals are in contact, the surfaces will be protected to prevent galvanic or corrosive action.

2.8 FINISH, AND CONTRAST

In buildings required to be handicapped-accessible, the characters and background of signs shall be eggshell, matte, or other non-glare finish. Characters and symbols shall contrast with their background - either light characters on a dark background or dark characters on a light background.

PART 3 EXECUTION

3.1 INSTALLATION

Signs shall be installed in accordance with approved manufacturer's instructions at locations shown on the detail drawings. Signs shall be installed plumb and true at mounting heights indicated, and by method shown or specified. Required blocking shall be installed as detailed. Signs that designate permanent rooms and spaces shall be installed on the wall adjacent to the latch side of the door. Where there is no wall space to the latch side of the door, including at double leaf doors, signs shall be placed on the nearest adjacent wall. Mounting location for such signage shall be so that a person may approach within 75 mm of signage without encountering protruding objects or standing within the swing of a door. Signs on doors or other surfaces shall not be installed until finishes on such surfaces have been installed. Signs installed on glass surfaces shall be installed with matching blank back-up plates in accordance with manufacturer's instructions. Install insert strips not more than 1 week prior to occupancy. Conform to ADA requirements for tactile graphics signage.

3.1.1 Anchorage

Anchorage shall be in accordance with approved manufacturer's instructions. Anchorage not otherwise specified or shown shall include slotted inserts, expansion shields, and powder-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine carriage bolts for steel; lag bolts and screws for wood. Exposed anchor and fastener materials are not acceptable. Where recommended by signage manufacturer, foam tape pads may be used for anchorage. Foam tape pads shall be minimum 2 mm thick closed cell vinyl foam with adhesive backing. Adhesive shall be transparent, long aging, high tech

formulation on two sides of the vinyl foam. Adhesive surfaces shall be protected with a 0.13 mm (5 mil) green flat stock treated with silicone. Foam pads shall be sized for the signage as per signage manufacturer's recommendations. Signs mounted to painted gypsum board surfaces shall be removable for painting maintenance. Signs mounted to lay-in ceiling grids shall be mounted with clip connections to ceiling tees.

3.1.2 Protection and Cleaning

The work shall be protected against damage during construction. Hardware and electrical equipment shall be adjusted for proper operation. Glass, frames, and other sign surfaces shall be cleaned in accordance with the manufacturer's approved instructions not more than 48 hours prior to date of substantial completion.

END OF SECTION

SECTION 10505

METAL LOCKERS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

Lockers shall be constructed of steel. Wherever possible, lockers shall be a manufacturer's standard product. Design of lockers not available as a manufacturer's standard product shall be by the Contractor using these specified requirements as the minimum level of product acceptability. Each double tier locker shall be a complete unit capable of relocation without modifying or adding components, except for anchors and scribes. Common sides or backs between adjacent units are not permissible. The dimensions specified are for the purpose of establishing general layout. Minor variations necessary to coordinate the details of construction will be permitted. Details not shown or otherwise specified shall be logical and compatible with the details specified or shall be in accordance with alternate details approved for use. All parts shall be manufactured to standards that will permit replacement without modifying remaining parts. Materials not definitely specified shall be of a quality consistent with the quality required for other materials and suitable for the end use.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Manual (1988) Metal Finishes Manual for Architectural and Metal Products

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TA-50 Gear Lockers; G
Athletic Lockers; G

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

TA-50 Gear Lockers; G
Athletic Lockers; G

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-04 Samples

TA-50 Gear Lockers; G
Athletic Lockers; G

Manufacturer's standard, full-size, product with all components and accessories as intended for installation.

Finish; G

Manufacturer's standard samples indicating color and texture of materials requiring color and finish selection.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Lockers may be delivered in "knocked down" state. Materials shall be kept dry, protected from weather and damage, and stored under cover. Materials shall be stored at approximately 21 degrees C for at least 48 hours prior to installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of metal lockers with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Protection of all surfaces until facility occupancy.
- (5) Coordination of overall lengths of locker rows with enclosing construction to maximize the number of lockers and minimize required closure strips.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Hinges

Hinges shall be brass or steel, not less than 1.5 mm thick, 5 knuckle type with tamper-proof construction, joint length not less than 60 mm, and chromium finish. When doors are closed, only a smooth beveled and rounded joint shall be exposed. Doors 1070 mm and less on the hinge side shall have two hinges; doors more than 1070 mm on the hinge side shall have three hinges. Full height doors on TA-50 Gear lockers shall have 4 hinges. Continuous piano type hinges with the same properties are also acceptable.

2.1.2 Handles and Latches

The handle shall be of the recessed type, of cast brass or bronze and shall be designed to permit locking by padlocking the handle to a steel keeper with a matching hole. A 14-gauge rectangular corrosion resisting steel shield shall be provided to protect the door from damage at the handle and padlock area. The interior components of the mechanism shall include locking bars or rods not less than 12 mm thick, two steel upper guides and two steel lower guides, three finger cam, applied strikes or reinforced openings for 2 point latching. The handle, keeper and locking bars or rods shall have a chromium finish, and all other components shall have a chromium, nickel, zinc or cadmium plate finish.

2.1.3 Clothes Hanging Hooks and Rods

Clothes hanging hooks and rods shall be chromium plated or zinc-coated steel.

2.1.4 Silencers

Silencers of rubber or similar resilient material shall be provided on doorframes at close proximity to each latching point to minimize noise when the door is closed. Silencers shall be replaceable.

2.1.5 Steel Sheet

Steel sheets shall be cold-rolled, commercial quality, stretcher level degree of flatness and of manufacturer's standard gauges specified.

2.2 LOCKER DESCRIPTION

2.2.1 TA-50 Gear Lockers

TA-50 gear lockers shall be single tier type. Each locker shall have one hinged door. Lockers shall be manufactured of 14 gauge expanded or punched steel. Frame shall be 12 gauge minimum. Each locker shall have a semi-adjustable interior mounted shelf equidistant in locker. General dimensions of each shall be in accordance with the following size.

Overall width: 610 mm
Overall depth: 610 mm
Overall height: 1830 mm
Concrete base: 100 - 150 mm height, install as indicated.

2.2.2 Athletic Lockers (Ventilated)

Lockers shall be two-compartment double tier type. Each compartment shall have a hinged door, ceiling mounted double clothes hanging hook and two wall mounted clothes hanging hooks each side of compartment. Overhead compartment identical to lower compartment. General dimensions of each double tier unit shall be in accordance with the following sizes selected from a manufacturer's standard unit. Locker mesh shall be manufacturer of 14 gauge expanded or punched steel. Frame shall be 12-gauge minimum.

Overall width: 300 mm
Overall depth: 460 mm
Overall height: 1830 mm
Concrete base: 100 - 150 mm height, install as indicated.

2.3 LOCKER CONSTRUCTION

2.3.1 Workmanship

Sheet metal bends shall be accurately formed. Cut edges shall be straight and smooth. Holes for the reception of mechanical fasteners shall be accurately punched or drilled and have all burrs removed. Butt welds shall extend full width of joining edges, shall be ground smooth and flush with adjacent surfaces when on exterior of lockers. Resistance welds shall be 5-mm minimum diameter and maximum spacing of 200 mm on center. Welds shall be thoroughly fused and sound, and shall be free of cracks, fissures, pits, holes, gas pockets, porosity and undercuttings. There shall be no sharp corners or protrusions of any kind in the final assembled lockers that could be considered harmful to the user or the stored items. Use of mechanical fasteners exposed to exterior of unit shall be limited to those required for application of hardware and scribes.

2.3.2 Base

Locker base shall be as indicated in the drawings.

2.3.3 Back and Side Panels

Back and side panels shall each be formed of sheet steel not lighter than 22 gauge and shall be reinforced if necessary to impart rigidity to unbroken spans. Back and side panel frame shall be 12 gauge minimum with 14 gauge expanded or punched steel.

2.3.4 Front

Front shall be not lighter than 18-gauge steel and multi-channel formed as required to provide strength and rigidity to side panels, top and bottom without exposing fasteners. Front shall be reinforced as necessary to serve as a stable mount and frame for doors and hardware. Fronts formed as part of side panels shall be equivalent to the specified 18-gauge steel multi-channel construction. With the door closed, clearance between door edge and frame shall be uniform and shall not exceed 3 mm and door face shall be flush with the face of the front.

2.3.5 Top

Top shall be not lighter than 22-gauge steel, flat exterior surface, and formed as required for securing to back, front and sides.

2.3.6 Bottom

Bottom shall be not lighter than 18-gauge steel and formed as required for securing to back, front and sides.

2.3.7 Doors

Doors shall be of double-wall type with not lighter than 22-gauge steel inside panel and not lighter than 20-gauge outside panel separated by not less than 20 mm of rigid mineral insulation cemented between the panels. Doors shall be reinforced or otherwise prepared for the reception of hardware and to provide strength and rigidity to the doors. Doors shall be 14 gauge expanded metal, with a 12 gauge frame. Doors shall be reinforced for reception of hardware.

2.3.8 Scribes and Closures

Scribes and closures shall be not lighter than 20 gauge.

2.3.9 Metal Finishes

Finish shall be an approved factory-applied baked-enamel, semi-gloss finish in accordance with manufacturer's standard finishes. Color will be selected of manufacturer's standard colors. General colors shall be as indicated in the drawings.

2.4 STATIC LOAD TESTS

When tested as specified herein, the door, including operation of hardware, shall not bind or otherwise fail and there shall be no failure, cracks, or permanent set exceeding 3 mm in any component. Test shall be performed with the locker in the normal upright position and anchored to simulate an actual installation, except back and sides shall be tested with the locker in the horizontal position with the test surface facing up.

2.4.1 Back and Sides

Each side and the back shall be tested separately using a 34 kg load within the area circumscribed by a 250 mm diameter circle located midway between supports. The load shall be applied for not less than 5 minutes.

2.4.2 Cabinet

The locker cabinet shall be tested using a 45-kg load on the top, a 22-kg load on the hat shelf, a 22-kg load on the clothes hanging rod or hooks, and a 45-kg load on the bottom. Load on the clothes hanging rod shall be hung from the center of the rod, and all other loads shall be within the area circumscribed by a 250 mm diameter circle located midway between supports. The loads shall be applied simultaneously for not less than 5 minutes.

2.4.3 Bottom Front Edge

With the cabinet loads in place, an additional load of 100 kg shall be applied not less than six times to the center of the bottom front edge to represent a user stepping on and off.

2.4.4 Doors

With the cabinet loads in place a 90 kg test load shall be suspended from the door by a rope located not more than 75 mm back from the latch side of the top edge of the door. In a normal manner the door shall be opened and closed through not less than 150 degrees for not less than six cycles. Counter weights or fastening of the cabinet to prevent tilting or upsetting will be permitted during this test.

PART 3 EXECUTION

3.1 INSTALLATION

Double tier lockers shall be assembled and positioned in accordance with the layout shown, set level, and secured in place. Lockers with backs to walls shall be secured to the wall with not less than four fasteners, using one fastener near each corner. Freestanding or island-type installations shall be secured to the floor with not less than four fasteners, using one fastener near each corner. In addition to securing to the floor or wall, lockers that are adjacent to each other, such as a back-to-back or a side-to-side layout, shall be secured to each other. Securing of adjacent lockers shall be with four fasteners located near the corners when a back-to-back installation is required. Fasteners to secure metal lockers in place shall penetrate two thicknesses of metal at each locker or shall be provided with washers. Scribes over 350 mm wide shall be secured to the building construction with concealed fasteners at intervals not to exceed 300 mm on center.

3.2 INSPECTION AND CLEANING

Inspect locker edges and surfaces to verify that there are no sharp corners or protrusions in the final assembled lockers that could be considered harmful to the user or stored items. Hardware shall be adjusted and left in good working order. Doors shall not stick or bind, but shall operate smoothly and easily. Lockers shall be cleaned and protected from damage until acceptance.

END OF SECTION

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SECTION 10520

FIRE EXTINGUISHER CABINETS AND ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Extinguisher Cabinets; G

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

Fire Extinguisher Cabinets; G

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-07 Certificates

Fire Extinguisher Cabinets; G

For cabinets that penetrate fire rated wall construction, provide certification attesting that the items comply with specified fire and safety code requirements to maintain fire rating of wall.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of exterior brick veneer wall construction with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Sheet Steel

Cold-rolled, annealed, stretcher leveled, bonderized or equivalent treatment and cleaned for the finish specified.

2.1.2 Glass

Glazing shall be standard double strength wire glass standard to the manufacturer.

2.2 FIRE EXTINGUISHER CABINETS

2.2.1 General

Fire extinguisher cabinets shall be semi-recessed type with square trim. Use surface mounted type only at locations where thickness of wall or adjacent structural components make a semi-recessed installation impossible. Cabinets shall be manufacturer's standard size as required to house a 9.5 liter, pressurized water type extinguisher. For number, type and location of cabinets and wall recesses required, see drawings. Extinguishers will be provided by the government.

2.2.2 Body Construction

Body shall be sheet steel not less than 20 gauge, one piece full-welded, with square corners or a seamless front, full-welded to back and at corners. Welds shall be continuous in full

depth and width, and dressed smooth on all exposed surfaces. Sides shall be cut, punched or drilled as necessary to receive hardware.

2.2.3 Door Construction

Door shall be hollow construction sheet steel not less than 20 gauge. Rails and stiles of one-piece rolled section, mitered and welded at corners. Provide glass retainers on inside for glass panel covering at least 75 percent of total door area.

2.2.4 Fabrication

All welds shall be ground smooth. All irregularities in finished surfaces from welding, cutting, punching or drilling shall be dressed smooth prior to painting. All foreign matter shall be removed from finished cabinet prior to painting.

2.2.5 Painting

After cleaning prime concealed and exposed metal surfaces with one coat of baked flat white enamel. Exposed interior surfaces, in addition to the prime coat, shall receive not less than two coats of white baked enamel finish. Exposed exterior surfaces, in addition to the prime coat, shall receive not less than two coats of red baked enamel finish.

2.2.6 Hardware

All cabinets shall be provided with continuous piano hinge (minimum 100 degree opening), pull handle and cam action latch. Handle shall be chromium, satin finish. Keyed locks are not required.

PART 3 EXECUTION

3.1 INSTALLATION

Provide two anchors on each jamb, spaced not more than 610 mm apart and adjustable. Anchors shall be a minimum of 50 mm wide, extend 200 mm into masonry, or 75 mm into concrete, or consist of direct bolting at steel framing. Where cabinet is located in a rated wall, provide manufacturer's fire rated cabinet or a gypsum wallboard surround system to maintain rated integrity of wall. Number, location and mounting height of fire extinguisher cabinets shall meet requirements of NFPA 10 and NFPA 101. Size recess openings such that cabinet front completely covers rough opening. Provide sealant at all seams between cabinets and wall surface.

END OF SECTION

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SECTION 10550

POSTAL SPECIALTIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM B 221 (1996) Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

BUILDER'S HARDWARE MANUFACTURER'S ASSOCIATION (BHMA)

BHMA 1201 (Auxiliary Hardware Standards)

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Manual (1988) Metal Finishes Manual for Architectural and Metal Products

U. S. DEPARTMENT OF DEFENSE (DOD)

DOD 4525.6M DOD Postal Manual

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Horizontal Mailboxes; G
Letter Box; G

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details. Include locking and keying information.

SD-03 Product Data

Horizontal Mailboxes; G
Letter Box; G

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

SD-07 Certificates

Horizontal Mailboxes; G
Letter Box; G

Certification that units comply with specified operational requirements and United States Postal Service standards.

1.3 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover.

1.4 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of postal specialties with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification of proper operation of all hardware

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL

Mailboxes and letter box shall be the standard products of a single manufacturer and shall be furnished as specified and detailed. Drawings show general configuration and number of products required. Items differing in minor details from those shown will be acceptable. All operating and size characteristics of postal specialties and accessories shall initially conform to United States Postal Service criteria and be capable of conversion to Postal use with only replacement of master lock. Initial locking/keying shall be configured for private operation consistent with Fort Lewis postal standards.

2.2 HORIZONTAL MAILBOX UNITS

2.2.1 Configuration

Mailboxes shall be front loading type. Each cluster unit shall have 35 mailbox compartments with 34 useable and one dedicated to master lock. Entire front panel of unit shall open on a continuous hinge. Framework supporting compartment doors shall be fabricated from high-strength extruded aluminum alloy. Units shall have solid sheet aluminum enclosure on sides, top, bottom and rear. Surfaces of the extruded trim and doors shall be striated with natural anodized aluminum finish and shall conform to NAAMM-01. A total of eight units shall provide 272 mailbox compartments at each Soldier Community Building.

2.2.2 Doors and Locks

Compartment doors shall be standard "A" size with plastic name/address card holders and individual numbers 1 through 272. Numbers shall be preprinted self-adhesive type, black color. Compartment doors shall be equipped with five pin cylinder locks capable of at least 1,000 key changes. Each compartment shall be keyed differently and master keyed. Provide two keys for each compartment. Compartment and master keys shall be delivered to the Contracting Officer, with record of each corresponding lock and key numbers. Provide 60 spare lock cylinders.

2.2.3 Dimensions

Nominal overall dimensions of each unit shall be 910 x 1040 x 420 mm (w x h x d). Verify dimension of manufacturer installed face trim.

2.3 LETTER BOXES

Letter boxes shall be recessed type with 6 mm aluminum plate construction. Nominal overall dimensions shall be 380 x 480 x 170 mm (w x h x d) including flange, with mail slot size 290 x 20 mm. Box shall conform to USPS criteria. Finish shall be aluminum matching mailboxes. Door shall have engraved text: "U.S. Mail". Door shall have a lock furnished and installed consistent with lock requirements for mailboxes and functioning on same master group. Mounting height shall meet ADAAG requirements for reach access.

PART 3 EXECUTION

3.1 INSTALLATION

All postal specialties shall be installed in strict conformance with manufacturer's written instructions. Locations shall be as indicated on drawings. Fasten all units to steel stud framing to preclude removal without tools. Mounting heights shall be as indicated on drawings and shall conform to USPS criteria.

3.2 SECURITY REQUIREMENTS

Mailboxes and letter boxes shall have all top, bottom, sides and back protected with expanded steel mesh. Mesh shall be mechanically fastened to steel studs and concealed under gypsum wallboard.

END OF SECTION

SECTION 10650

OPERABLE PARTITIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 423	(2000) Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 90	(1999) Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions
ASTM E 413	(1987; R 1999) Rating Sound Insulation
ASTM E 557	(2000) Guide for the Installation of Operable Partitions

1.2 GENERAL REQUIREMENTS

The Contractor shall supply and install flat, individual function, top supported, manual operation, acoustical operable partitions as shown on the drawings, including all operating hardware, seals, track, rollers, as needed to close the specified opening. The partition shall be made up of a series of rigid, flat wall panels. Each panel shall be a one-piece assembly nominally 1.2 m wide. Unless otherwise specified, the wall shall be composed of the least number of panels. The mechanical seal of the panels shall actuate with a single operating action. Operable panel system in closed position shall provide acoustic separation of STC 50 per ASTM E 413.

1.2.1 Manual Operation

The manual operation shall be accomplished with less than 89 N force to start movement at the rate of 1.02 m/s. Operable seals and jamb closure shall be operated manually by removable crank handle. Closure to the lead wall shall be by use of a jamb closure mechanism with final closure accomplished by means of exerting pressure against wall.

1.3 SUBMITTALS

All items designated with a G, including product literature, calculations, component data, certificates, diagrams and drawings, shall be submitted concurrently in one complete system submittal. Omission of any required submittal item from the package shall be sufficient cause for disapproval of the entire submittal. Unless otherwise indicated in the submittal review

commentary, disapproval of any item within the package shall require a re-submittal of the entire system package, in which all deficiencies shall be corrected. Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Operable Partitions; G

Drawings containing complete schematic diagrams and details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearances for maintenance and operation.

SD-03 Product Data

Operable Partitions; G

Manufacturer's descriptive data, performance charts, catalog cuts, and installation instructions.

SD-04 Samples

Operable Partitions; G

Color samples of specified surfaces and finishes to match those specified. Finish and color requirements shall not be limited to manufacturer's standard selections in order to meet these requirements.

SD-07 Certificates

Materials; G

Operable Partitions; G

Certificate attesting that the materials meet the requirements specified and that partitions have specified acoustical and flame retardant properties, as determined by test.

SD-10 Operation and Maintenance Data

Operable Partitions; G

Six complete copies of operating instructions outlining the procedures required for manually operated partitions. The instructions shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and operating features. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 year and 3 years of

service. Six complete copies of maintenance instructions explaining routine maintenance procedures including inspection, adjustments, lubrication, and cleaning. The instructions shall list possible breakdown, methods of repair, and a troubleshooting guide. The instructions shall include equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the job site in the manufacturer's original, unopened packages and shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that provide at least a 2 year warranty period shall be provided.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of operable partitions with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Coordination of door stack pocket size with cumulative panel thickness of partition in stored position.
- (5) Adjustment of panels as required to provide light and sound separation between adjacent rooms.
- (6) Protection of panels until occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to

the site. Partition finishes shall have a Class A rating when tested in accordance with ASTM E 84.

2.1.1 Operable Panels

Panels shall be aluminum frame with gypsum substrate laminated to steel substrate. Substrate may be varied if necessary to comply with specified STC rating. Frames shall be fabricated of 6063-T6 aluminum. Frames or edge trim shall be designed to capture and protect full height of vertical edge of panel. Nominal weight of panel shall be at least 40 kg per Sq. Meter.

Partitions shall be individually supported with top hung, hardened, ball bearing carriers located in the track and internally.

Panels shall be not more than 1.2 m wide, except for end closure panels, and shall be full height to track. Panels shall lock in place to form a stable, rigid partition. Panel thickness (100 mm nominal) and composition shall be designed to provide an STC rating of not less than 50 in accordance with ASTM E 90 and ASTM E 413.

2.1.2 Panel Surface Finish

Panel surface finish shall be factory applied vinyl fabric with woven backing and minimum weight of 400 g/m, style and color as indicated on drawings. Partition finish shall have a flame spread rating of not more than 25 in accordance with ASTM E 84.

2.1.3 Panel Frame Finish

Panel frame shall be clear anodized aluminum.

2.1.4 Hardware

Operable partitions shall have manufacturer's standard hardware. Hardware shall be anodized aluminum with a natural finish, chrome plated or brass plated metal, or painted finish.

2.1.5 Seals

Horizontal top and bottom seals shall consist of a retractable mechanical seal. Top seal shall provide minimum 30 mm operating clearance retracted, while bottom seal provides nominal 40 mm operating clearance from floor when retracted. Bottom seals will exert a downward force when fully extended. Top and bottom seals shall be engaged with removable crank operator. Vertical interlocking seal between panels shall be with a deep nested tongue and groove type of dual durometer polyvinylchloride to provide required sound seal and at least 15 mm of interlock.

2.1.6 Vinyl Restrictions

Vinyls shall contain a non-mercury based mildewcide and shall be manufactured without the use of cadmium-based stabilizers.

2.1.7 Track

Track shall be manufacturer's standard product designed for the weight of the finished partition and all accessories. Track shall be recessed as shown and shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track sections shall be provided in the maximum lengths practicable, not less than 1.8 m long except at ends of runs where short length is required. Suitable joint devices such as interlocking keys shall be provided at each joint to provide permanent alignment of track. Track shall support adjoining ceiling, soffit and/or plenum sound barrier construction. Connection of track to structure above shall be designed by the panel manufacturer.

2.1.8 Metal Soffit

Soffit shall be provided as an integral part of the track. Soffit shall be of metal of adequate thickness to protect the ceiling from damage by door operation. Soffit shall be clear anodized finish.

2.1.9 Support Carriers

Panels shall be supported by at least two multi-wheeled carriers functioning within overhead track and/or within the panel. Carrier shall be multi-wheeled with hardened steel ball bearings. Wheels shall utilize precision ground steel ball bearings with hardened races inside molded polymer tires.

2.1.10 Accessories and Options

Accessories listed below shall be provided on both faces of panels:

- a. Provide inset porcelain enamel on steel marker boards. Size as indicated on drawings. Marker board attachment to panels shall be permanent.
- b. Provide inset tackboards, coordinate location and size with marker boards and as indicated on drawings.
- c. Provide inset eraser/marker tray pocket below each marker board.

2.2 OPERATION

Panels shall be deployable manually and individually with top and bottom seals set by operation of a removable crank handle in panel edge. Top and bottom seals shall activate simultaneously. Closure at tail jamb shall be by expanding jamb section on end panel. Panel shall otherwise be identical to all other panels. Jamb closure shall provide a means to compensate for wall irregularities. Seal force against adjacent wall shall be at least 100 kg. Jamb extension shall be in the range of 75 to 160 mm, driven by a mechanical rack and pinion device. Seal and jamb operators shall be located between 1000 and 1250 mm above finished floor. In storage position the panels shall be entirely retracted within the stack alcoves indicated.

2.3 ACOUSTICAL PROPERTIES

Panels in fully closed position shall have an overall STC of at least 50. Acoustical performance shall have been tested and certified by a nationally recognized testing laboratory. Tests shall have been conducted to meet all requirements of ASTM E 90.

PART 3 EXECUTION

3.1 INSTALLATION

Installation shall be in accordance with the manufacturer's approved installation instructions. All installation procedures shall be performed by a manufacturer authorized and trained installer. Shop drawings and manufacturer's written instructions shall be strictly adhered to not only for panels, but all supporting framing as well.

3.2 ACOUSTICAL SEPARATION

To ensure optimum acoustic separation between adjacent rooms, coordinate installation of operable partition system with construction of sound baffles in plenum space above partition. Installation of fixed baffles shall not restrict future adjustment or removal of panel track, carriers or panel segments.

3.3 CLEANING

Following installation, all track, panel and surrounding surfaces shall be cleaned of soil, grease fingerprints and other contaminates. Panel finishes shall be protected until building is ready for occupancy. All installation debris shall be removed from the site on a daily basis.

3.4 TRAINING

Following completion of installation, contractor shall demonstrate proper operation and maintenance practices for partition system to user representatives. Training shall be at least two hours in duration. Copies of all operational devices, tools and O & M manuals shall also be made available at this time. O & M manuals required for this training session are in addition to requirements indicated in SECTION: OPERATIONS AND MAINTENANCE MANUALS.

END OF SECTION

SECTION 10800

TOILET ACCESSORIES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICANS WITH DISABILITIES ACT (ADA)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM C 1036 (1991; R 1997) Flat Glass

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-2380 (Rev A)(Canc. Notice 1) Dispenser, Paper Towel

CID A-A-2398 (Rev BC); (Canc. Notice 1 Curtain, Shower and Window
(Metric - SI)

CID A-A-2668 (Basic); Dispenser, Toilet Paper, Cabinet

UNIFORM FEDERAL ACCESSIBILITY STANDARDS (UFAS)

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Finishes;
Accessory Items; G

Manufacturer's descriptive data and catalog cuts indicating materials of construction, fasteners proposed for use for each type of wall construction, mounting instructions, operation instructions, and cleaning instructions.

SD-04 Samples

Finishes; G
Accessory Items; G

One sample of each accessory proposed for use. Approved samples may be incorporated into the finished work, provided they are identified and their locations noted.

SD-10 Operation and Maintenance Data

Electric Hand Dryer; G

One complete copy of maintenance instructions listing routine maintenance procedures and possible breakdowns and repairs. Instructions shall include simplified wiring and control diagrams and other information necessary for unit maintenance.

1.3 GENERAL REQUIREMENTS

Toilet accessories as specified herein shall be provided where indicated in accordance with paragraph "SCHEDULE". Porcelain type, tile-wall accessories are specified in SECTION: CERAMIC TILE. Each accessory item shall be complete with the necessary mounting plates, anchors and fasteners. Concealed mounting plates shall be of sturdy construction with corrosion resistant surfaces. Accessories shall be installed consistent with the requirements of the ADAAG, except in barracks room modules where conforming installation is preferred but not required.

1.4 DELIVERY, STORAGE, AND HANDLING

Toilet accessories shall be wrapped for shipment and storage, delivered to the jobsite in manufacturer's original packaging, and stored in a clean, dry area protected from construction damage and vandalism.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of toilet accessories with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verify proper installation and operation, including finished appearance.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MANUFACTURED UNITS

Accessory items shall be the standard products of manufacturers who have produced like items for at least 3 years. To the greatest extent possible, all accessories shall be purchased from the same manufacturer. At minimum, all accessories of the same type in the same building shall be identical.

2.1.1 Anchors and Fasteners

Anchors and fasteners shall be capable of developing a restraining force commensurate with the strength of the accessory to be mounted and shall be suited for use with the supporting construction and finish. Exposed fasteners shall have oval heads and shall be finished to match the accessory.

2.1.2 Finishes

Except where noted otherwise, finishes on metal shall be provided as follows:

Metal	Finish	BHMA
Stainless steel	No. 4 satin finish	630
Carbon steel, copper alloy, and brass	Chromium plated, bright	626

2.2 ACCESSORY ITEMS

Accessory items shall conform to the requirements specified below. All accessory items shall have a smooth finish.

2.2.1 Grab Bar (GB)

Grab bar shall be 18 gauge, 32 mm Type 304 stainless steel. Grab bar shall be form and length as indicated. Exposed mounting flange shall have mounting holes concealed. Grab bar shall have peened non-slip surface. Installed bars shall be capable of withstanding a 2.225 kN vertical load without coming loose from the fastenings and without obvious permanent deformation. Space between wall and grab bar shall be 38 mm.

2.2.2 Medicine Cabinet (MC)

Medicine cabinet shall be constructed with cold-rolled carbon steel sheet of not less than 0.76 mm thick, formed from a single sheet of steel or shall have mechanically formed spot welded or any other suitable joints. Nominal size of cabinet shall be 600 x 750 x 120 mm, conforming to Class 2.

2.2.2.1 Swinging Door Cabinet, Class 2

Swinging door cabinet assembly shall be as indicated. Assembly shall be recess mounted. Cabinet shall be located centrally behind the door and shall contain a minimum of two shelves. Door hinges shall be piano type stainless steel or carbon steel. Magnets used in door catches shall be permanent type. Doors shall be complete with glass mirror and shall be reversible..

2.2.3 Mirrors, Glass (MG)

Glass for mirrors shall be Type I transparent flat type, Class 1-clear. Glazing Quality q1 6 mm thick conforming to ASTM C 1036. Glass shall be coated on one surface with silver coating, copper protective coating, and mirror backing paint. Silver coating shall be highly adhesive pure silver coating of a thickness which shall provide reflectivity of 83 percent or more of incident light when viewed through 6 mm thick glass, and shall be free of pinholes or other defects. Copper protective coating shall be pure bright reflective copper, homogeneous without sludge, pinholes or other defects, and shall be of proper thickness to prevent "adhesion pull" by mirror backing paint. Mirror backing paint shall consist of two coats of special scratch and abrasion-resistant paint and shall be baked in uniform thickness to provide a protection for silver and copper coatings which will permit normal cutting and edge fabrication.

2.2.3.1 Mirror Frames

Except for the mirrors located behind the vanity in barracks room modules, all mirrors shall be framed. Frames shall be angle type fabricated of roll formed 18 gauge type 304 stainless steel. Corners shall be heliarc welded, ground and polished smooth. Frame shall have a satin finish. Mirror shall be mounted with concealed, hanging brackets at top and bottom of frame, and connected with tamper resistant set screws. Back plates shall be one piece type.

2.2.3.2 Frameless Mirrors

Mirrors located behind vanity in barracks room modules shall be frameless and mounted with semi-concealed clips. Frameless mirror shall have a polished edge.

2.2.4 Paper Towel Dispenser (PTD)

Paper towel dispenser shall conform to CID A-A-2380, shall be constructed of not less than 0.683 mm Type 304 stainless steel, and shall be surface mounted. Dispenser shall have a towel compartment sized to dispense at least 400 C-fold, single-fold or quarter-fold towels. Locking mechanism shall be tumbler key lock.

2.2.5 Combination Paper Towel Dispenser/Waste Receptacle Units (PTDWR)

Dispenser/receptacle shall be semi-recessed and shall have a capacity of 400 sheets of C-fold, single-fold, or quarter-fold towels. Waste receptacle shall be designed to be locked in unit and removable for service. Locking mechanism shall be tumbler key lock. Waste receptacle shall have a capacity of 45 L. Unit shall be fabricated of not less than 0.8 mm stainless steel welded construction with all exposed surfaces having a satin finish. Waste receptacle that accepts reusable liner standard for unit manufacturer shall be provided.

2.2.6 Sanitary Napkin Disposer (SND)

Sanitary napkin disposal shall be constructed of Type 304 stainless steel with removable leak-proof receptacle for disposable liners. Fifty disposable liners of the type standard with the manufacturer shall be provided. Receptacle shall be retained in cabinet by tumbler lock. Disposer shall be provided with a door for inserting disposed napkins, and shall be partition mounted, double access or surface mounted as shown.

2.2.7 Sanitary Napkin and Tampon Dispenser (SNTD)

Sanitary napkin and tampon dispenser shall be surface mounted. Dispenser, including door shall be Type 304 stainless steel and shall dispense both napkins and tampons with a minimum capacity of 20 each. Dispensing mechanism shall be for coin operation. Coin mechanisms shall have minimum denominations of 10 cents, 25 cents, and 50 cents. Doors shall be hung with a full-length corrosion-resistant steel piano hinge and secured with a tumbler lock. Keys for coin box shall be different from the door keys.

2.2.8 Shower Curtain (SC)

Shower curtain shall conform to CID A-A-2398, Style I, size to suit conditions. Curtain shall be anti-bacterial nylon/vinyl fabric. Color shall be white.

2.2.9 Shower Curtain Rods (SCR)

Shower curtain rods shall be Type 304 stainless steel 32 mm OD by 1.24 mm minimum straight to meet installation conditions.

2.2.10 Soap Dispenser (SD)

Soap dispenser shall be surface mounted, liquid type consisting of a vertical Type 304 stainless steel tank with holding capacity of 1.2 with a corrosion-resistant all-purpose valve that dispenses liquid soaps, lotions, detergents and antiseptic soaps.

2.2.11 Soap Holder (SH)

Soap holder shall be recessed Type 304 stainless steel. Separate supports shall be stainless steel.

2.2.12 Shelf, Metal, Heavy Duty (SMHD)

Heavy duty metal shelf shall be minimum of 18 gauge stainless steel with hemmed edges. Shelves over 750 mm shall be provided with intermediate supports. Supports shall be minimum of 16 gauge, shall be welded to the shelf, and shall be spaced no more than 750 mm apart. Supports shall be anchored directly to studs. Shelf size as indicated on drawings.

2.2.13 Soap and Grab Bar Combination, Recessed (SGR)

Soap and grab bar combination shall be recessed type and shall be Type 304 stainless steel, satin finish.

2.2.14 Towel Bar (TB)

Towel bar shall be stainless steel with a minimum thickness of 0.38 mm. Bar shall be minimum 19 mm diameter, or 16 mm square, length as indicated on drawings. Finish shall be satin.

2.2.15 Towel Pin (TP)

Towel pin shall have concealed wall fastenings, and a pin integral with or permanently fastened to wall flange. Maximum projection shall be 100 mm. Design shall be consistent with design of other accessory items. Finish shall be satin.

2.2.16 Toilet Tissue Dispenser (TTD)

Toilet tissue holder shall be Type II - surface mounted with two rolls of standard tissue mounted horizontally.

2.2.17 Toilet Tissue Dispenser (TTD2)

Toilet tissue holder shall be Type II - surface mounted with one roll of standard tissue mounted horizontally.

2.2.18 Toilet Tissue Dispenser (TTD3)

Toilet tissue holder shall be Type III – recess mounted with two rolls of standard tissue stacked vertically. Cabinet shall be stainless steel with a satin finish.

2.2.19 Waste Receptacle (WR)

Waste receptacle shall be Type 304 stainless steel, designed for recessed mounting. Reusable liner, of the type standard with the receptacle manufacturer, shall be provided. Capacity shall be not less than .1 cubic meter. Receptacles shall be open type without doors on disposal area. Doors for access to the waste compartment shall have continuous hinges. Locking mechanism shall be tumbler key lock.

2.2.20 Electric Hand Dryer (EHD)

Electric hand dryer shall be wall mounted and shall be designed to operate on 110/125 volts, 60 cycle, single phase alternating current with a heating element core rating of not more than 2100 watts. Dryer housing shall be of single piece construction and shall be chrome plated steel, satin finish.

PART 3 EXECUTION

3.1 INSTALLATION

Toilet accessories shall be securely fastened to the supporting construction in accordance with the manufacturer's approved instructions. Accessories shall be protected from damage from the time of installation until acceptance.

3.2 CLEANING

Material shall be cleaned in accordance with manufacturer's recommendations. Alkaline or abrasive agents shall not be used. Precautions shall be taken to avoid scratching or marring of surfaces.

3.3 SCHEDULE

3.3.1 Barracks (not including SCB)

Accessories Required

Room or Space WR	MC	MG	PTD	SC	SCR	SGR	SMHD	SD	SH	TB	TTD2
---------------------------	----	----	-----	----	-----	-----	------	----	----	----	------

Each Room Module:

1 Bath	-	-	-	1	1	1	-	-	-	2	1
1 Vanity	2	1	-	-	-	-	-	-	-	2	-

3.3.2 Soldier Community Buildings

Accessories Required

Room or Space	GB	MG	PTDWR	SND	SD	SMHD	TTD
---------------------	----	----	-------	-----	----	------	-----

Each of two buildings:

A110	1	1	1	1	1	-	1
A111	1	1	1	-	1	-	1
A112	-	-	1	-	-	2	-

3.3.3 Large Battalion Headquarters

Accessories Required

Room or Space TP	MG	PTD	SD	TTD	TTD3	GB	PTDWR	SND	SNTD	SC	SCR
105	1	-	3	3	-	1pair	1	3	1	-	-
-											
106A	1	1	-	-	-	-	-	-	-	-	-
-											
106B	1	-	1	-	-	-	-	-	-	1	1
2											
106C	-	-	1	-	-	-	-	-	-	1	1
2											
108	1	-	3	3	-	1pair	1	-	-	-	-
-											
203D	-	1	-	-	-	-	-	-	-	-	-
-											
203E	1	-	1	-	1	-	1	-	-	-	-
-											
207	1	-	1	1	-	1pair	1	1	1	-	-
-											
212	1	-	4	-	-	-	1	-	-	3	3
6											

3.3.4 Medium Company Operations Facility

Accessories Required

Room or Space TP	MG	PTDWR	SMHD	SD	SH	TTD	SNTD	SND	SCR	SC	PTD
101	1	1	1	2	1	1	-	1	1	1	-
2											
111A	2	1	2	2	-	-	1	-	-	-	-
-											
111B	-	-	-	3	3	2	-	2	3	3	-
7											
112A	5	2	5	5	-	-	-	-	-	-	-
-											
112B	-	-	-	5	5	5	-	-	5	5	-
9											
210	-	-	-	-	-	-	-	-	-	-	1
-											
211	1	1	1	2	1	1	-	1	1	1	-
2											

END OF SECTION

SECTION 10990

MISCELLANEOUS BUILDING SPECIALTIES

PART 1 GENERAL

1.1 SCOPE

This section includes requirements for the following specialty items:

- a) Markerboards and Tackboards
- b) Telephone Enclosures
- c) TV/VCR Wall Mounting Bracket
- d) Recessed Floor Mats
- e) Projection Screens

NOTE: For recessed entrance gratings see SECTION: MISCELLANEOUS METAL

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ALUMINUM ASSOCIATION (AA)

AA DAF-45 (1997) Designation System for Aluminum Finishes

NATIONAL ASSOCIATION OF ARCHITECTURAL METAL MANUFACTURERS (NAAMM)

NAAMM AMP 500 Manual (1988) Metal Finishes Manual for Architectural and Metal Products

1.3 GENERAL REQUIREMENTS

Like items of equipment provided hereunder shall be the end products of one manufacturer in order to achieve standardization for appearance, operation, maintenance, spare parts and manufacturer's service.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Markerboards and Tackboards; G
Telephone Enclosures; G
TV/VCR Wall Mounting Bracket; G

Recessed Floor Mats; G
Projection Screens; G

Drawings indicating locations and typical elevations of each type of item. Drawings shall show vertical and horizontal dimensions, full size sections, thickness of materials, and fastening details.

SD-03 Product Data

Markerboards and Tackboards; G
Telephone Enclosures; G
TV/VCR Wall Mounting Bracket; G
Recessed Floor Mats; G
Projection Screens; G

Manufacturer's descriptive data, catalog cuts, installation instructions, and recommended cleaning instructions.

1.4 DELIVERY AND STORAGE

Materials shall be delivered to the project site in manufacturer's original unopened containers with seals unbroken and labels and trademarks intact. Materials shall be kept dry, protected from weather and damage, and stored under cover. Items shall not be unpacked until they are needed for installation.

1.5 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1-year period shall be provided. Specialties shall be warranted against defects in materials or workmanship for a minimum period of one year from date of final acceptance.

1.6 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of postal specialties with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification of proper operation of all equipment and hardware.
- (5) Protection of all specialties until facility occupancy.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MARKERBOARDS AND TACKBOARDS

2.1.1 Marker boards

Writing surface shall be white, porcelain enamel coating on 24-gauge steel, designed for use with dry erase marking pens. Porcelain steel sheet shall conform to ASTM C 346 Type 54T and meet PEI S104. Porcelain coating shall be 5-mil minimum thickness. Steel face sheet shall be permanently bonded to 12 mm thick particleboard substrate. Vapor barrier shall be .120 mm thickness aluminum sheet bonded to back of substrate. Marker board unit shall be framed with 6063-TS satin anodized edge trim. Finish frame and continuous marker/eraser tray shall be hardwood. Frame shall have nominal face width of 40 mm, mitered safety corners. Frame shall not have exposed fasteners on face. Provide manufacturer's standard nominal 25 mm map rail trim. Size as indicated on drawings.

2.1.2 Tackboards

Tackable surface shall be vinyl fabric covered composite panel of 3 mm cork over 9 mm wood fiberboard panel. Fabric shall be 20 ounce per linear yard weight with linen backing conforming to ASTM E 84, Class A. Fiberboard panel shall also be Class A rated. Submit manufacturer's standard fabric color samples for selection. Frame shall match specification for Marker boards.

2.1.3 Mounting

Marker boards and tackboards shall be mounted to wall with concealed hanger bar type mounting system. Install boards plumb, level and parallel with adjacent edges and conforming to manufacturer's written installation instructions. Provide standard marker and eraser kits.

2.2 TELEPHONE ENCLOSURES

Provide flush panel, modular type telephone shelf and enclosure. Unit shall be of fully welded construction and designed for surface mounting. Body and shelf shall be constructed of 18-gauge satin finish stainless steel. Vertical side panel dividers shall be 12 mm clear acrylic with radius top and bottom front corners. Full width directory shelf shall be mounted below shelf at phone. Provide phone configured for coin, charge and "house phone" use. Enclosure shall have nominal dimensions of 660 x 1020 x 410 mm (w x h x d). Mounting height shall conform to ADAAG requirements. Coordinate acceptable phone with service provider. Coordinate location of phone circuit(s) with mounting location. Install plumb, level and parallel with adjacent edges and conforming to manufacturer's written instructions.

2.3 TV/VCR WALL MOUNTING BRACKET

TV/VCR wall mount system shall be a single arm design capable of supporting up to a 680 mm (diagonal) screen television (N.I.C.) with a minimum load capacity of 56 kg. A separate VCR mount, carried by the same arm, shall support a VCR (N.I.C.) with maximum dimensions of 435 x 105 mm. Mounting arm shall provide at least 100 degrees of side to side rotation, articulate from two swivel points and provide at least 10 degrees of forward tilt. Contractor

shall submit shop drawings detailing the mounting system and all additional wall construction or reinforcement (including additional studs, mounting plates and anchors) required for installation. Walls at mounting locations shall not be covered with gypsum wall board until shop drawing approval is received. Installation shall conform to manufacturer's written instructions. Coordinate location of power and CATV outlets on wall immediately behind TV/VCR location to minimize length of cable required.

2.4 RECESSED FLOOR MATS

Recessed floor mats shall be installed at interior locations, and in sizes shown, as indicated on drawings. Frames shall be extruded aluminum alloy cast into concrete floor. Frame configuration and depth shall be selected to meet detailed requirements for level bed or drain pan installation as indicated on drawings. Grid treads shall run perpendicular to the line of pedestrian traffic. Where required by frame or bed/pan depth, thicken floor section at grating to provide minimum concrete thickness indicated. Color of all aluminum grating and frame components shall be black anodized. Coordinate slab recess and frame installation to ensure flush and level installation of grating surface with surrounding finished floor. Coordinate location of drain assembly and piping where required.

2.4.1 Rail/Tread Grid

Grids shall be composed of "I" section type rails of extruded 6105-T5 aluminum alloy with slotted aluminum tread surface designed to receive carpet strips. Rails shall be stabilized with intersecting bars. Tread depth shall be 40 to 50 mm with separate vinyl cushions on the bottom of each tread rail. Spacing of tread surface and carpet strips shall have open gaps between them to permit debris capture. Entire grid panel shall be removable as a single unit to permit periodic cleaning of pit.

2.4.2 Carpet Inserts

Carpet inserts shall be colorfast, solution dyed 100% nylon with 12-mil monofilament and a nominal weight of 33 oz. per square yard. Carpet and filaments shall be fusion bonded to backing. Each carpet strip shall be a continuous piece with splices for the full length of tread segment. Carpet shall be anti-static type, contain an antimicrobial additive and be Scotchguard treated.

2.4.3 Recessed Frame

Frame material shall be 6063-T5 aluminum alloy extrusion with mitered corners. Frame shall be permanently cast into concrete floor. Nominal exposed face width of 13 mm.

2.4.4 Reference Product

Reference product is provided for illustration purposes and does not preclude the use of an equal product meeting this specification:

"Pedigrid" with Heavy Duty Carpet insert and Level Base Frame by Construction Specialties, Inc. Carpet fabric color: NO. 9321 "Pewter".

NOTE: For recessed entrance gratings (installed at exterior locations) see SECTION: MISCELLANEOUS METALS

2.5 PROJECTION SCREENS

Projection screens shall be manual pull down, front projection type, configured for wall mount or recessed/concealed in ceiling mount as indicated. Case shall be extruded aluminum material, black color. Screen material shall be seamless, washable, flame retardant and 100 percent brighter than standard matte white screens. Minimum gain shall be 1.5, with viewing angle up to 120 degrees. Screen shall be color corrected for CRT projectors and perform well for slide or overhead projectors. Screen shall have a black boundary zone around the entire image area. Image area shall be 1500 x 2000 mm (w x h) minimum size. Locate screens as indicated.

PART 3 EXECUTION

3.1 INSTALLATION

The Contractor shall install building specialties as detailed, at locations indicated, as herein specified and in accordance with the manufacturer's written installation instructions. Conflicts in installation details or specifications shall be brought to the attention of the Contracting Officer and resolved prior to the installation of the building specialty in question. All materials shall be installed plumb, level and firmly attached to adjacent construction as appropriate. All require hardware, brackets and appurtenant features shall be provided with all building specialties for a complete, fully operational installation. Care shall be taken not to damage adjacent construction during installation of building specialties.

3.1.1 Installation of Recessed Floor Mats

Careful attention shall be given to the installation of floor frames and recesses to ensure that the mat grating and frame surface is installed level and flush with the adjacent finished floor surface and is solid and stable under foot traffic without rocking or displacement of any type.

3.2 PROTECTION AND REPAIR/REPLACEMENT OF DAMAGE ITEMS

Building specialties shall be installed and handled in a manner that shall prevent damage. Any damage that occurs shall be repaired to "like new" condition to the satisfaction of the Contracting Officer or the damaged item shall be replaced.

3.3 ADJUSTMENT AND CLEANING

All specialties shall be adjusted to conform with the operating characteristics identified by the manufacturer for proper operation. All mounting locations shall be inspected to ensure a solid anchorage. All loose components, sharp edges and other potential safety hazards to occupants shall be corrected. Clean all surfaces as recommended in writing by the manufacturer immediately prior to initial occupancy.

3.4 TRAINING

Not more than 14 days prior to facility occupancy the contractor shall demonstrate proper operation of all building specialties, including maintenance procedures, to representatives of the Contracting Officer and the user. Training shall include distribution of copies of all printed O&M materials produced by the manufacturer. Distribution of these materials does not

relieve the contractor of the requirements of SECTION: OPERATION AND MAINTENANCE
MANUALS.

END OF SECTION

SECTION 11020

SECURITY VAULT DOOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS AA-D-00600 (Rev B) Door, Vault, Security

1.2 GENERAL REQUIREMENTS

The vault door unit shall be a steel security-vault type door with frame, day gate, and ramp type threshold, and shall be a standard product of a manufacturer specializing in this type of fabrication.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-03 Product Data

Vault Door and Frame; G

Manufacturer's catalog data including catalog cuts and brochures. The data shall show that the proposed vault door unit conforms with the requirements in FS AA-D-00600, and has been tested and approved by the General Services Administration (GSA).

SD-07 Certificates

Vault Door and Frame; G

Certification shall state that vault-door units that do not bear the GSA label are constructed to Class 5 standards.

1.4 DELIVERY AND STORAGE

Door and frame assemblies shall be delivered to the job site in a protective covering with the brand and name clearly marked thereon. Materials delivered to the job site shall be inspected for damage, and unloaded with a minimum of handling. Storage shall be in a dry location with adequate ventilation, free from dust, water, and other contaminants, and which permits easy

access for inspection and handling. Door assemblies shall be stored off the floor on non-absorptive strips or wood platforms. Damage to doors and frames shall be prevented during handling. Damaged items that cannot be restored to like-new condition shall be replaced.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of security vault doors with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Adherence to all security requirements of installation and transfer to user.
- (4) Shop drawings include explicit identification of coordination with other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 VAULT DOOR AND FRAME

Design and construction of the door and frame assembly shall conform to FS AA-D-00600. The door shall be Class 5, Type "IR" - right opening swing with optical device or "IL" - left opening swing with optical device, as indicated on drawings, Style K - key change combination lock. The optical device shall permit observation from the inside to the outside of the vault.

2.2 DAY GATE

Day gates shall be provided at Arms Room entrances. Day gates shall be manufactured and installed as designed and detailed in the drawings. Size and mounting position of day gate shall be coordinated with the vault door furnished, and shall provide access control and visual security. The gate shall be hinged on the same side as the vault door, shall swing into the vault, and shall have a locking device operable from outside by key and from inside by knob or handle. Day gate shall be of steel construction throughout. Provide high security hasp (NSN 5340-00-178-7872) accessible from vault interior. Gate shall be constructed with a pass through opening complete with shelf.

PART 3 EXECUTION

3.1 INSTALLATION

The vault door assembly shall be installed in strict compliance with the printed instructions and drawings provided by the manufacturer. The day gate shall be installed in a manner that will not interfere with operation of the release handle on the inside of the vault door. After installation, the door, the locking mechanism, and the inner escape device shall be adjusted for proper operation.

END OF SECTION

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SECTION 11315

PACKAGE LIFT STATION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M198 (1994) Joints for Circular Concrete Sewer and Culvert
Pipe Using Flexible Watertight Gaskets

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B1.20.1 (1983) Pipe Threads, General Purpose (Inch)

ASME/ANSI B16.1 (1989) Cast Iron Pipe Flanges and Flanged Fittings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B16.3 (1992) Malleable Iron Threaded Fittings Classes 150
and 300

ANSI B16.11 (1996) Forged Steel Fittings, Socket Welded and
Threaded

ANSI B31.1 (1996) Process Piping

ANSI/AWWA C151/A21.51 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or
Other Liquids

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53 (1996) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated
Welded and Seamless

ASTM A 123/A 123M (1997; Rev. A) Zinc (Hot-Galvanized) Coatings on
Products

ASTM A 536 (1984; R 1993) Ductile Iron Castings

ASTM A 615/A 615M (1996; Rev. A) Deformed and Plain Billet-Steel Bars for
Concrete Reinforcement

ASTM C 443 (1994) Joints for Circular Concrete Sewer and Culvert
Pipe, Using Rubber Gaskets

ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM D 1784	(1996) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 1785	(1996; Rev. B) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2241	(1996; Rev. B) 1980 Poly (Vinyl Chloride) (PVC) Plastic Pipe (SDR-PR)
ASTM D 2464	(1996; Rev. A) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1997) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1997; Rev. A) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 3139	(1996; Rev. A) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM F 477	(1996; Rev. A) Elastomeric Seals (Gaskets) for Joining Plastic Pipe

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C104/A21.4	(1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C110/A21.10	(1993) Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm), for Water and Other Liquids
AWWA C111/A21.11	(1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115/A21.15	(1994) Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C500	(1993) Metal-Seated Gate Valves for Water and Systems
AWWA C509	(1994) Resilient-Seated Gate Valves for Water and Sewerage Systems
AWWA C600	(1993) Installation of Ductile-Iron Water Mains and Their Appurtenances

AWWA M23 (1980) PVC Pipe - Design and Installation

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1 (1993) Motors and Generators

1.2 DESCRIPTION OF WORK

The work includes providing submersible sewage pump station and related work. Provide system complete and ready for operations. Pump station system including equipment, materials, installation, and workmanship shall be as specified herein.

1.3 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data; GA.

Pipe and fittings

Check valves

Gate valves

Submersible sewage pumps

Pump motor

Flexible flanged coupling

SD-10 Operation and Maintenance Data; GA.

Submersible Sewage Pumps Data Package 3

Include pumps, alarms, and motors. Data for submersible sewage pump station data shall include all information on all equipment, alarm panel and controls, pumps and pump performance curves, and station layout.

1.4 DELIVERY, STORAGE, AND HANDLING OF MATERIALS

1.4.1 Delivery and Storage

Inspect materials delivered to site for damage. Unload and store with minimum handling. Store materials in enclosures or under protective covering. Store rubber gaskets not to be installed immediately under cover, out of direct sunlight. Do not store materials directly on the ground. Keep interior of pipes and fittings free of dirt and debris.

1.4.2 Handling

Handle pipe, fittings, valves, and other accessories in such manner as to ensure delivery to the trench in sound, undamaged condition. Avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged. Carry pipe to the trench; do not drag it.

1.5 EXCAVATION, TRENCHING, AND BACKFILLING

Provide in accordance with Section 02315, "Excavation, Filling and Backfilling for Buildings," except as specified herein.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

Provide pressure piping, air release valves, and related accessories for force main piping outside the sewage wet well and valve vault in accordance with Section 02531, "Sanitary Sewers".

2.1.1 Ductile-Iron Pipe

ANSI/AWWA C151/A21.51, thickness Class 52.

2.1.1.1 Flanged Pipe

AWWA C115/A21.15, ductile iron.

2.1.1.2 Fittings

AWWA C110/A21.10, flanged. Provide flanged joint fittings within wet well and valve vault as indicated. Provide mechanical joint fittings outside valve vault enclosure as indicated. Fittings shall have pressure rating at least equivalent to that of the pipe.

2.1.1.3 Joints

AWWA C115/A21.15 for flanged joints. Bolts, nuts, and gaskets for flanged connections shall be as recommended in the Appendix to AWWA C115/A21.15. Flange for setscrewed flanges shall be of ductile iron, ASTM A 536, Grade 65-45-12, and shall conform to the applicable requirements of ASME/ANSI B16.1, Class 250. Setscrews for setscrewed flanges shall be 1310 MPa tensile strength, heat treated, and zinc-coated steel. Gasket for setscrewed flanges shall conform to the applicable requirements for mechanical-joint gaskets specified in AWWA C111/A21.11. Design of setscrewed gasket shall provide for confinement and compression of gasket when joint to adjoining flange is made.

2.1.2 PVC Plastic Pressure Pipe and Associated Fittings

2.1.2.1 Pipe and Fittings Less Than 100 mm Diameter

Pipe, couplings and fittings shall be manufactured of materials conforming to ASTM D 1784, Class 12454-B.

- (1) Screw-Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 Schedule 80, with joints meeting requirements of 1.03 MPa working pressure, 1.38 MPa hydrostatic test pressure, unless otherwise shown or specified. Fittings for threaded pipe shall conform to requirements of ASTM D 2464, threaded to conform to the requirements of ASME B1.20.1 for use with Schedule 80 pipe and fittings. Pipe couplings when used, shall be tested as required by ASTM D 2464.
- (2) Push-On Joint: ASTM D 3139, with ASTM F 477 gaskets. Fittings for push-on joints shall be iron conforming to AWWA C110/A21.10 or AWWA C111/A21.11. Iron fittings and specials shall be cement-mortar lined (standard thickness) in accordance with AWWA C104/A21.4.
- (3) Solvent Cement Joint: Pipe shall conform to dimensional requirements of ASTM D 1785 or ASTM D 2241 with joints meeting the requirements of 1.03 MPa working pressure and 1.38 MPa hydrostatic test pressure. Fittings for solvent cement jointing shall conform to ASTM D 2466 or ASTM D 2467.

2.1.3 Insulating Joints

Provide between pipes of dissimilar metals a rubber gasket or other approved type of insulating joint or dielectric coupling which shall effectively prevent metal-to-metal contact between adjacent sections of piping.

2.1.4 Accessories

Provide flanges, connecting pieces, transition glands, transition sleeves, and other adapters as required.

2.1.5 Flexible Flanged Coupling

Provide flexible flanged coupling applicable for sewage as indicated. The flexible flanged coupling shall be designed for a working pressure of 2.41 MPa.

2.2 VALVES AND OTHER PIPING ACCESSORIES

2.2.1 Gate Valves in Valve Vault

AWWA C500 and AWWA C509. Valves conforming to AWWA C500 shall be outside-screw-and-yoke rising-stem type with double disc gates and flanged ends. Valves conforming to AWWA C509 shall be outside-screw-and-yoke rising-stem type with flanged ends. Provide valves with handwheels that open by counterclockwise rotation of the valve stem. Stuffing boxes shall be bolted and constructed so as to permit easy removal of parts for repair. Valves shall be of one manufacturer.

2.2.2 Check Valves Less Than 100 mm Diameter

Neoprene ball check valve with integral hydraulic sealing flange, designed for a hydraulic working pressure of 1.21 MPa.

2.2.3 Identification Tags and Plates

Provide valves with tags or plates numbered and stamped for their usage. Plates and tags shall be of brass or nonferrous material and shall be mounted or attached to the valve.

2.2.4 Pipe Support

The pipe support shall be schedule 40 galvanized steel piping conforming to ASTM A 53. Provide either ANSI B16.3 or ANSI B16.11 galvanized threaded fittings.

2.2.5 Miscellaneous Metals

Bolts, nuts, washers, anchors, and supports necessary for the installation of equipment shall be stainless steel.

2.2.6 Quick Disconnect System with Hydraulic Sealing Flange

The quick disconnect system shall consist of a steel base plate for supporting the pumps, a hydraulic sealing flange, pump guide rails and the discharge pipe supports. The two guide rails shall be galvanized steel in accordance with ASTM A 123/A 123M. A steel lifting chain shall be provided for raising and lowering the pump in the basin. Guides shall be built onto the pump housing to fit the guide post in order to assure perfect alignment between the pump and guide rails.

2.2.7 Wet Well Vent

Galvanized ASTM A 53 pipe with insect screening.

2.3 SUBMERSIBLE SEWAGE PUMPS

Provide submersible sewage pumps as shown on the drawings. Provide submersible, centrifugal sewage pumps of the non-clogging type with passageways designed to pass 76 mm diameter spheres without clogging. Pump capacity and motor characteristics as indicated. Design pump to operate in a submerged or partially submerged condition. Provide an integral sliding guide bracket and two guide bars capable of supporting the entire weight of the pumping unit.

2.3.1 Casing

Provide hard, close-grained cast iron casing which is free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects. Design casings to permit replacement of wearing parts. Passageways shall permit the smooth flow of sewage and shall be free from sharp turns and projections.

2.3.2 Impeller

Provide non-clogging type bronze impeller. Make impeller with smooth surfaces, free flowing with the necessary clearance to permit objects in the sewage to pass. Fit and key, spline, or thread impeller on shaft, and lock in such manner that lateral movement will be prevented and reverse rotation will not cause loosening.

2.3.3 Shaft and Shaft Seals

Provide shaft of stainless steel. Provide mechanical seal of double carbon and ceramic construction with mating surfaces lapped to a flatness tolerance of one light band. Hold rotating ceramics in mating position with stationary carbons by a stainless steel spring. Oil lubricate bearings.

2.3.4 Bearings

Provide heavy duty ball thrust bearing or roller type bearing of adequate size to withstand imposed loads. Oil lubricate bearings.

2.3.5 Pump and Motor

The pump and motor shall be assembled on a single stainless steel shaft in a heavy duty cast-iron shell. The pump support legs shall be free standing cast-iron.

2.4 PUMP MOTOR

Provide submersible sewage pumps in wet well 240 volt, single phase, and for submersible pumps. Motor horsepower shall be not less than pump horsepower at any point on the pump performance curve. Fit motors with lifting "eyes" capable of supporting entire weight of pump and motor.

2.5 PUMP CONTROL SYSTEM

Provide a sealed mercury float switch control system as indicated. Automatically alternate operation from one pump to the other and start second pump in the event first pump cannot handle incoming flow. Provide "hand-off-auto" switch for each pump. Provide independent adjustable high and low water level switches. Floats, supports, and alarm shall be provided. Metal parts, if used, shall be of bronze or equivalent corrosion resistant material.

2.5.1 Float Assembly Description

The device shall be a direct acting float switch consisting of a normally- open mercury switch enclosed in a float. The float assembly shall be pipe mounted. The float shall be molded of rigid high-density polyurethane foam, color-coded and coated with a durable, water and corrosion-resistant jacket of clear urethane. The connecting cable and support pole shall be provided in accordance with the manufacturers recommendations. A cast aluminum NEMA Type 4 junction box shall be provided to connect the float assembly. The box shall have a gasketed cover with a tapped float fitting and conduit entrance pipe threaded opening. The floats shall be mounted at fixed elevations as shown. When the liquid level being sensed rises or falls past the float, the floats shall tilt and operate their switches thus causing sequential turn-on turn-off of the pump.

2.5.2 Alternator

Provide an alternator control switch to operate in connection with each float. Alternator control switch shall alternate the operation of the pumps and operate both pumps if the water level rises above the second high water level. A time delay function and devices shall be incorporated in the alternator controls such that both sewage pumps cannot be started

simultaneously for an adjustable period of 10 to 120 seconds after shutdown. The delay function shall operate in any condition of start-up in either normal or emergency operational mode.

2.5.3 Sewage Pump Alarm and Control Panel

Alarm panel shall be enclosed in a NEMA IV enclosure and have a flashing red light with long life bulb in guarded enclosure and 15 mm diameter horn. Horn shall emit 120 dB at 3 meters. Alarm horn and light shall be powered from 12V DC power supply with battery backup. Provide a rechargeable battery rated to power both the horn and light for a minimum of two hours upon loss of main power. Provide circuitry to automatically recharge the battery after main power is restored. Full charge of battery shall take no more than 20 hours. Panel shall have power on light, push to test button for horn and light and push to silence button for horn and light with automatic reset for next alarm. Alarm shall activate under the following conditions:

- a. High liquid level as sensed by float switch
- b. Loss of main power
- c. No flow light as sensed by limit switch on the check valve

2.5.4 Electrical Requirements

Furnish motors with their respective pieces of equipment. Motors, controllers, contactors, and disconnects shall be as specified in Division 16 Specification Sections. Furnish internal wiring for components of packaged equipment as an integral part of the equipment. Power wiring and conduit for field installed equipment shall be provided.

2.5.5 Electric Motor

The electric motor shall be hermetically sealed. The power cable shall be sealed inside of the motor end bell. The cable shall be neoprene covered with a flexible metal cover over it for its full length.

2.6 UNDERGROUND EQUIPMENT ENCLOSURE

2.6.1 Access Hatch Cover

Provide aluminum access hatch cover as indicated. The access hatch shall include lifting mechanism, automatic hold open arm, slam lock with handle, and flush lift handle with red vinyl grip. The automatic hold open arm shall lock in the 90 degree position. The cover shall be 6 mm diamond plate with 6 mm channel frame and continuous anchor flange. The access hatch cover shall be capable to withstand a live load of 1500 kg/sq. meter. Provide stainless steel cylinder lock with two keys per lock. Key all the locks the same.

2.6.2 Wet Well

Provide concrete wet well with inside diameter as indicated. Precast structures may be provided in lieu of cast-in-place structures.

2.6.2.1 Cast-In-Place Concrete Structures

Provide wet well with a compressive strength of 25 MPa at 28 days as specified in Section 03300, "Cast-In-Place (CIP) Concrete."

2.6.2.2 Precast Concrete Structures

ASTM C 478, except as specified herein. Provide precast concrete structures with a compressive strength of 30 MPa at 28 days and an air entrainment of 6 percent, plus, or minus 2 percent and a minimum wall thickness of 125 mm. ASTM A 615/A 615M reinforcing bars. ASTM C 443 or AASHTO M198, Type B gaskets for joint connections. Base and first riser shall be monolithic.

2.6.3 Wet Well Base Material

Provide crushed stone as indicated and specified in Section 02315, "Excavation and Fill." Provide polyethylene vapor barrier as indicated and specified in Section 03300, "Cast-In-Place (CIP) Concrete."

PART 3 EXECUTION

3.1 INSTALLATION

Provide pump station in accordance with drawings and requirements of the respective equipment manufacturers. Dampen and isolate equipment vibration.

3.1.1 Installation of Ductile-Iron Pressure Lines

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled, "General Requirements for Installation of Pipelines" of Section 02531, "Sanitary Sewers," and with the requirements of AWWA C600 for pipe installation, joint assembly, and valve-and-fitting installation.

- a. Make flanged joint with gaskets, bolts, and nuts specified for this type joint. Make flanged joints up tight, taking care to avoid undue strain on flanges, fittings, and other accessories. Align bolt holes for each flanged joint. Use size bolts for the bolt holes; use of undersized bolts to make up for misalignment of bolt holes or for any other purpose will not be permitted. Do not allow adjoining flange faces to be out of parallel to such degree that the flanged joint cannot be made watertight without overstraining the flange.

3.1.2 Installation of PVC Plastic Pressure Pipe and Fittings

Unless otherwise specified, install pipe and fittings in accordance with paragraph entitled "General Requirements for Installation of Pipelines" of this section and with the recommendations for pipe joint assembly and appurtenance installation in AWWA M23, Chapter 7, "Installation."

a. Pipe Less than 100 mm Diameter:

(1) Threaded joints shall be made by wrapping the male threads with joint tape or by applying an approved thread lubricant, than threading the joining members together. The joints shall be tightened with strap wrenches which will not damage the pipe and fittings. The joint shall be tightened no more than 2 threads past hand-tight.

(2) Push-On Joints: The ends of pipe for push-on joints shall be beveled to facilitate assembly. Pipe shall be marked to indicate when the pipe is fully seated. The gasket shall be lubricated to prevent displacement. Care shall be exercised to ensure that the gasket remains in proper position in the bell or coupling while making the joint.

(3) Solvent-weld joints shall comply with the manufacturer's instructions.

3.1.3 Valves

Installation of Valves: Install gate valves conforming to AWWA C500 in accordance with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C500. Install gate valves conforming to AWWA C509 in accordance with AWWA C600 for valve-and-fitting installation and with the recommendations of the Appendix ("Installation, Operation, and Maintenance of Gate Valves") to AWWA C509. Install check valves in accordance with the applicable requirements of AWWA C600 for valve-and-fitting installation, except as otherwise indicated. Make and assemble joints to gate valves and check valves as specified for making and assembling the same type joints between pipe and fittings.

3.1.4 Steel Piping

Installation of steel piping shall be in accordance with ANSI B31.1. Jointing compound for pipe threads shall be PTFE pipe thread paste or PTFE powder and oil.

3.1.5 Force Main

Provide in accordance with Section 02532, "Force Mains; Sewer."

3.1.6 Equipment Installation

Install equipment in accordance with these specifications and the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before installing piping. Install piping to avoid imposing stress on any equipment. Match flanges accurately before securing bolts.

3.2 FIELD TESTS AND INSPECTIONS

Perform all field tests, and provide all labor, equipment, and incidentals required for testing, except that water and electric power needed for field tests will be furnished as set forth in Division 1. The Contractor shall produce evidence, when required, that any item of work has been constructed in accordance with contract requirements. Allow concrete to cure a

minimum of 5 days before testing any section of piping where concrete thrust blocks have been provided.

3.2.1 Testing Procedure

Test piping in accordance with the Section 02531, "Sanitary Sewers". All equipment shall be tested in operation to demonstrate compliance with the contract requirements.

3.2.2 Sewage Lift Station

Pumps and controls shall be tested, in operation, under design conditions to insure proper operation of all such equipment. All appliances, materials, water, and equipment for testing shall be provided by the Contractor, and all expenses in connection with the testing shall be borne by him. Testing shall be conducted after all equipment is properly installed, electrical services and piping are installed, liquid is flowing, and the pump station is ready for operation. All defects discovered shall be corrected to the satisfaction of the Contracting Officer, and all tests repeated, at the expense of the Contractor, until the equipment is in proper working order.

END OF SECTION

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SECTION 11452

RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION LABORATORIES (AGAL)

AGAL Directory	(1996) Directory of AGA & CGA Certified Appliances and Accessories
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(2000) Carbon Structural Steel
ASTM A 123/A 123M	(2000) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 240/A 240M	(2000) Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels
ASTM A 269	(2000) Seamless and Welded Austenitic Stainless Steel Tubing for General Service
ASTM B 32	(1996) Solder Metal
ASTM D 520	(2000) Zinc Dust Pigment

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA LD 3	(1995) High-Pressure Decorative Laminates

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION (SMACNA)

SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997) HVAC Duct Construction Standards - Metal and Flexible
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UNDERWRITERS LABORATORIES (UL)

UL Elec Equip Dir	(1999) Electrical Appliance and Utilization Equipment Directory
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1.2 GENERAL REQUIREMENTS

Residential appliances (including washing machines and dryers) shall be of the sizes and types shown. Equipment, materials, and fixtures required for use in conjunction with the items to be furnished by the Government (GFGI and GFCI) shall be furnished and installed by the Contractor. Any other equipment, materials, and fixtures indicated on the drawings and schedules shown shall be furnished and installed by the Contractor. Appliance models indicated for Government purchase are subject to change for a variety of reasons. Contractor shall review appliance purchase lists with the Contracting Officer during the course of construction to ensure that any revisions that may affect the contractor's work are coordinated.

1.2.1 Mechanical, Electrical, and Plumbing Work

Plumbing systems, including final connections, shall be in accordance with SECTION: PLUMBING, GENERAL PURPOSE. Electrical equipment, motors, wiring, and final connections shall be in accordance with SECTION: ELECTRICAL WORK, INTERIOR. Gas piping and accessories, including final connections, shall be in accordance with SECTION: GAS PIPING SYSTEMS. Duct work and accessories shall be in accordance with SECTION: AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. Painting shall be in accordance with SECTION: PAINTING, GENERAL.

1.2.2 Verification of Dimensions and Coordination of Project Data

The Contractor shall become familiar with all details of the work and shall advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall perform the following:

- a. Horizontal and vertical dimensions shall be field verified and coordinated with cabinetry production where necessary.
- b. Contract drawings and submittal data shall be reviewed for accuracy and completeness.
- c. The installed utility capacity and location shall be field checked.
- d. Critical systems/components shall be reviewed for application and capacities such as for ducting to exhaust hoods and gas and water connections.
- e. Delivery shall be coordinated for access through finished openings and vertical handlings limitation within the building.

1.2.3 Standard Products

Materials and equipment shall be the standard products of manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. The experience used shall include applications of equipment and materials under similar circumstances and of similar size. When two or more of the same products are supplied they shall be products of one manufacturer. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.2.4 Nameplates

Each item of equipment shall bear a stainless steel, aluminum, or engraved polyester nameplate, as standard with the manufacturer, located in a conspicuous position and permanently fastened to the equipment. Name or identification plates shall be of the size standard with the manufacturer for the particular piece of equipment provided. Name plates shall reflect the name of the manufacturer/trade name, serial number, make, and model number, pertinent ratings, operating characteristics, and other information as standard with the manufacturer, date of manufacture, electrical characteristics, and other applicable data, such as flow rate, temperature, pressure, capacity, and material of construction. Separate equipment identification plates with the contract number marked thereon, shall be securely fastened to the surface of each piece of equipment.

1.2.5 American Gas Association Laboratories Standards

Gas-burning equipment shall be designed for operation with the type of gas specified and shall be approved by AGAL. Acceptable evidence of meeting the requirements of the applicable AGAL Directory standards shall be either AGAL mark on equipment, a photostatic copy of the AGAL appliance certificate, a listing of the specific equipment or appliance in the AGAL Directory of Certified Appliances and Accessories, or a certified test report from a

nationally recognized independent testing laboratory, indicating that the specified equipment has been tested and conforms to the requirements of the applicable AGAL standards.

1.2.6 Underwriters Laboratories Standards

Electrically operated equipment shall be in accordance with applicable UL standards. Evidence of meeting the requirements shall be a UL label on the equipment, a UL listing mark per UL Elec. Equip Dir. or a certified test report from a nationally recognized independent testing laboratory indicating that the specific food service equipment has been tested and conforms to the applicable UL standards.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Residential Appliances; G
Installation; G

Data consisting of a complete list of equipment and materials. Detail drawings showing complete wiring, piping, and schematic diagrams, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work, including clearances for maintenance and operation.

- a. Detail drawings by Contractor shall be separate drawings and shall be the contractor's standard sheet size, but not smaller than the contract drawings, and indicate the appliances with itemized schedule, and special conditions drawings indicating size and location of slab depressions, cores, wall openings, blockouts, ceiling pockets, blocking grounds, ceiling and] wall, access panels, and above ceiling hanger assemblies, rough-in plumbing/mechanical systems and rough-in electrical systems.
- b. Detail drawings by manufacturer shall be separate drawings; sheet size shall be manufacturer's standard size and indicate item number, name, and quantity, construction details, sections, and elevations, adjacent walls, columns, and equipment, plumbing and electrical schematics, and fabricated fixtures with single electrical or plumbing connection, and service access panels required for maintenance or replacement of mechanical or electrical components.
- c. Detail drawings by the Contractor that show the size, type, and location of equipment drain lines, and floor drains. Drawings shall indicate drain lines from equipment, distances of drain lines and floor drain receptacles from equipment and aisles, and elevation views of drain piping and floor drains.

SD-03 Product Data

Residential Appliances; G

Manufacturer's descriptive and technical literature, performance charts and curves, catalog cuts, and installation instructions. Brochures shall have front and rear protective covers with labeled project name and include an index indicating item number, quantity, description, and manufacturer, a fly sheet for each component indicating item number, name, quantity, manufacturer, optional equipment, modification, special instruction, and utility requirements, and catalog specifications sheets.

SD-06 Test Reports

Testing; G

Test reports in booklet format showing all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-10 Operation and Maintenance Data

Residential Appliances; G

Six complete copies of the service manual, not later than 1 month prior to the date of beneficial occupancy, with data for each different item of material and equipment specified. Service manuals shall include:

- a. Front and rear protective covers with labeled project name.
- b. Index indicating item number, quantity, description, manufacturer's name, and model number.
- c. Maintenance instructions for stainless steel and plastic laminate.
- d. Manufacturer's catalog specification sheets and manufacturer's detail and control drawings.
- e. Manufacturer's operation manual outlining the step-by-step procedures for equipment installation, startup, basic operation features, and operation shutdown.
- f. Manufacturer's maintenance manual listing routine maintenance procedures, possible breakdowns, repairs, and troubleshooting guides. The instructions shall include simplified diagrams for the equipment as installed.
- g. Manufacturer's list of parts and supplies with current unit price and address of manufacturer's parts supply warehouse.

1.4 DELIVERY AND STORAGE

1.4.1 Delivery

Unless otherwise directed, the following procedures shall apply:

- a. Field assembled fixed equipment integrated into structure shall be sent to jobsite when required.
- b. Fixed equipment not integrated into structure shall be sent to the jobsite after completion of finished ceilings, lighting, and acidizing of the finished floor and wall systems, including painting.
- c. Major movable equipment shall be delivered to inventory in a secured area for interim jobsite storage, or if secured area is not available, when fixed equipment installation/clean-up has been completed.
- d. Minor appliances and loose items shall be delivered to the jobsite when the Contracting Officer is prepared to receive and inventory such items.

1.4.2 Storage

Items delivered and placed into storage shall be stored with protection from weather, humidity, and temperature variation, dirt and dust, or other contaminants.

1.4.3 Protection of Contractor Furnished and Installed (CFI) Manufactured Equipment and Appliances

Protective materials (plastic sheeting, cardboard, rigid or pliable foams, etc.) shall be taped to surfaces as required by equipment shape and installation access requirements. Finished surfaces of appliances exposed in final construction shall be protected at all times prior to beneficial occupancy. Remove protection when directed by C.O.R.

1.4.4 Protection of Government Furnished and Government Installed (GFGI) Appliances

Government furnished and installed appliances may be stored and/or installed within the facilities under construction prior to beneficial occupancy. Contractor shall at all times protect appliances located on site from incidental damage or contamination. The Government will coordinate all deliveries as to time and location with the Contractor in order to minimize job site conflicts. Contractor shall protect GFGI appliances consistent with requirements listed in paragraph "CFI Appliances".

1.4.5 Protection of Government Furnished and Contractor Installed (GFCI) Appliances

Contractor shall protect GFCI appliances consistent with requirements listed in paragraph "CFI Appliances".

1.4.6 Prohibited Use of Appliances/Equipment

Appliances shall not be used as tool and material storage, work bench, scaffold, or stacking area. Appliances shall not be used for their intended purpose except for testing necessary to verify full functionality following installation.

1.4.7 Damaged Appliances/Equipment

Contractor shall immediately submit documentation to the Contracting Officer with a recommendation of action for repair or replacement and the impact on project schedule.

1.5 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of residential appliances with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Coordination of all utility connections including water, waste, gas and electricity.
- (5) Protection of all appliances.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 MATERIALS

Recyclable materials shall conform to EPA requirements in accordance with SECTION: RECYCLED / RECOVERED MATERIALS. Other materials shall conform to the following:

2.1.1 Stainless Steel, Nonmagnetic

ASTM A 167 or ASTM A 240/A 240M: 18-8, 300 Series, austenitic, polished to No. 3 or 4 finish on exposed surfaces.

2.1.2 Stainless Steel Pipe and Tubing

ASTM A 269. Pipe and tubing shall be seamless or welded, of the gauge specified, of true roundness, and of material as specified for stainless steel. Seamless tubing shall be thoroughly annealed, pickled, and ground smooth. Welded tubing shall be thoroughly heat-treated, quenched to eliminate carbide precipitation and then drawn true to size and roundness, and ground. Tubing shall be given a No. 3 or 4 finish when exposed to view.

2.1.3 Galvanizing Repair Compound

ASTM D 520, Type I pigment.

2.1.4 Brazing Material

AWS A5.8, class shall be as applicable.

2.1.5 Steel Structural Shapes for Framing

ASTM A 36/A 36M. Structural shapes shall be uniform, ductile in quality, and shall be free of hard spots, runs, checks, cracks and other surface defects. Sections shall be galvanized by the hot-dip process, conforming to ASTM A 123/A 123M.

2.1.6. Solder Material

ASTM B 32, Sn96.

2.2 APPLIANCES (GFGI)

2.2.1 Combination Microwave Refrigerator/Freezer (at Barracks Room Modules)

Microfridge model MF-10 TP incorporates both appliances in a stacked unit. Overall size of unit is 600 x 1810 x 711 mm (w x h x d). Coordinate cabinet size and location to permit appliance location as indicated on drawings. Appliance may be purchased in single or dual plug configuration. Confirm type acquired and style of plug. Coordinate electrical outlet requirements.

2.2.2 Dispensing Ice Machine (at Soldier Community Building)

Ice machine model shall be Manitowac QFA-291. Unit is water cooled and will provide up to 180 pounds of ice storage. Overall size of unit is 760 x 1540 x 810 mm (w x h x d). Coordinate power, water supply and drainage (storage hopper and condenser) requirements including backflow prevention if necessary.

2.3 APPLIANCES (GFCI)

2.3.1 Washing Machines (at Soldier Community Building)

Maytag high-efficiency washer model MAH20PN. Overall size 686 x 1060 x 718 mm (w x h x d). Confirm and coordinate facility built in requirements for water, waste and electrical connections.

2.3.2 Heavy Duty (Commercial) Washing Machines (at Soldier Community Building)

Maytag commercial front load washer, model MFR35. Overall size 855 x 1320 x 890 (w x h x d). Confirm and coordinate facility built in requirements for water, waste and electrical connections.

2.3.3 Clothes Dryers (at Soldier Community Building)

Maytag model MLG15PR gas stacked dryer. Overall size 686 x 699 x 1816 mm (w x h x d). Confirm and coordinate facility built in requirements for electrical and gas connections and gang venting of grouped dryers. Each dryer unit incorporates two stacked dryers capable of independent operation.

2.4 APPLIANCES (CFI)

2.4.1 Range (at Barracks Room Modules)

Range shall be an electric drop-in type complete with oven and smooth ceramic type cooktop. Oven shall be 4 cubic foot capacity, self-cleaning, with 2 racks and glass window door. Cooktop shall be four element, radiant type with "Ceran" or similar surface and 'hot surface' indicator lights. Nominal size of range shall be 780 x 710 x 670 mm (w x h x d). Coordinate size and configuration of cabinetry cutout with actual unit selected. Coordinate power outlet requirements with actual unit selected. Color of unit shall be white on white.

Representative products:

General Electric model JDP46WDWW.

Maytag model MEP5770A.

Whirlpool model RS696PXGQ

2.4.2 Exhaust Hood (at Barracks Room Modules)

Exhaust hood shall be built-in, exhaust to exterior type. Features shall include multi-speed fan, removable/washable grease filters and internal hood light to illuminate range cooking surface. Nominal size of exhaust hood shall be 760 x 150 x 445 mm (w x h x d). Design of hood shall not create any exposed sharp metal edges. Coordinate size and configuration of cabinetry cutout with actual unit selected. Coordinate power outlet, and vent ducting requirements with actual unit selected. Color of unit shall be white.

Representative products:

Broan Model 463011

GE Appliances Model JV535CWW

Whirlpool Model RH2330XJQ

2.5 ELECTRICAL WORK

Electrical systems, components and accessories shall be certified to be in accordance with NFPA 70 and the following:

2.5.1 Installed Equipment Load

Should the electrical load of the approved equipment differ from that specified or shown on the drawings, the contractor shall provide and install electrical service compatible with the approved equipment.

2.5.2 Electrical Equipment and Components

Appliances furnished under this section shall have loads, voltages, and phases compatible with building system, and shall conform to manufacturer standards.

2.5.3 Cords and Caps

Food service equipment cord/caps shall be coordinated with related receptacles. All 120/208/240 volt "plug-in" equipment shall have Type SO or SJO cord and a plug with ground, fastened to frame/body of item.

2.5.4 Heating Elements

Electrically heated equipment shall have thermostatic controls.

PART 3 EXECUTION

3.1 INSTALLATION

Equipment shall be installed at locations shown in accordance with NSF-01 and the manufacturer's written instructions. The Contractor shall make provision for the plumbing, heating, and electrical connections and for equipment indicated as being furnished and installed by the Government.

3.1.1 Equipment Connections

Equipment connections shall be complete for all utilities. Unless otherwise specified, exposed piping shall be chromium-plated copper alloy.

3.1.2 Backflow Preventers

Backflow preventers shall be furnished as specified in SECTION: PLUMBING, GENERAL PURPOSE. The Contractor is responsible to install backflow preventers as shown on the contract drawings and at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any source of nonpotable water, or other contaminant. Backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or will be located below the level of the contaminant. Backflow preventers shall be provided of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of waste or other contamination into the potable water system.

3.1.3 Gas Equipment

Installation of equipment shall conform to NFPA 54. A heavy duty steel cable, 75 mm to 150 mm (3 inches to 6 inches) shorter than the equipment connector shall be fastened to the equipment and the walls.

3.1.4 Plumbing Work

Plumbing final connection points of equipment shall be tagged, indicating item number, name of devices or components, and type of utility (water, gas, steam, drain). Extensions of indirect

waste fitting shall be provided to open-sight hub drain, floor sink or floor drains from food service equipment.

3.1.5 Fastening Devices

Fastening devices shall be of the same material as the metal being joined when joint pieces are of similar metal. Fastening devices shall be stainless steel when stainless steel is joined to dissimilar metal. Stud bolts shall be a minimum of M6 (1/4-20) stainless steel with length necessary to accept washers, and required nuts, and shall be welded 225 mm (9 inches) on center maximum. Exposed surfaces of equipment shall be free of bolts, screws, and rivet heads. Stainless steel stud bolts shall be used to fasten tops of counters or tables to angle framing and trim to other surfaces. Such bolts shall be of the concealed type. Threads of stud bolts which are on the inside of fixtures and are either visible or might come in contact with a wiping cloth, shall be capped with chrome plated washers, lock washers, and chromium-plated brass cap nuts. Wherever bolts are welded to the underside of trim or tops, the reverse side of the welds shall be finished uniform with the adjoining surface of the trim or the top. Dimples at these points will not be acceptable.

3.1.6 Welding

3.1.6.1 Welding Rods

Welding shall be done with welding rods of the same composition as the sheets or parts welded.

3.1.6.2 Weld Quality

Welds shall be strong and ductile. Welds shall be free of imperfections such as pits, runs, spatter, cracks, low spots, voids, and shall be finished to have the same color as the adjoining surfaces. Butt welds made by welding straps under seams, or by filling in with solder, or by grinding will not be acceptable. Welded joints shall be homogeneous with the sheet metal. Spot welding shall not be substituted for continuous welding. Welds in galvanized steel made after galvanizing, and the adjacent areas where galvanizing is damaged, shall be cleaned and coated with galvanizing repair compound.

3.1.7 Soldering

Soldering shall serve only as a filler to prevent leakage and shall be made with solder material. Stainless steel requiring soldering shall first be cleaned of discoloration and then have a soldering flux applied. Excess or remaining flux and catalytic material shall be removed after the soldering has been completed, and the entire soldered joint and adjacent metallic surfaces shall be cleaned with a liquid alkaline or neutralizing agent to prevent any attack on the surrounding metallic surfaces by the soldering flux.

3.1.8 Brazing

Brazing shall be accomplished with brazing material. Brazing shall be used only on copper tubing to brass and bronze connection fittings.

3.2 TESTING

Equipment shall be inspected and tested under operating conditions after installation. If inspection or test shows defects, such defects shall be corrected, and inspection and test shall be repeated. Refrigerator tests shall include the following:

3.2.1 Operating Tests

An operating test shall be performed on all items (except GFGI) after complete installation and adjustment. The failed test item shall be corrected and the test shall be rerun.

3.2.2 Equipment Start-Up/Demonstration

As necessary, the Contractor shall obtain the services of the manufacturer's representative experienced in the installation, adjustment and operation of the equipment specified. The representative shall supervise the start-up, adjustment, and testing of the equipment, prior to the demonstration. Equipment shall be carefully tested, adjusted, and regulated in accordance with the manufacturer's instructions and shall be so certified in writing. A thorough operational demonstration shall be provided of all equipment and instructions furnished for general and specific care and maintenance. Selected items of equipment and attendees shall be scheduled, with the Contracting Officer, at least 2 weeks in advance of demonstration periods.

3.3 Clean and Adjust

Debris resulting from this work, as the installation progresses, shall be removed from the jobsite on the same day. All appliances, (except GFGI) prior to demonstration, shall be cleaned and polished, both interior/exterior. Drawer slides and casters shall be lubricated and adjusted. Pressure regulating valves, timed-delay relays, thermostatic controls, and temperature sensors, shall be adjusted, as required, for proper operation. Faucet aerators and line strainers shall be cleaned or replaced. Damage to painted finishes shall be touched up.

END OF SECTION

SECTION 12490

WINDOW TREATMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

FEDERAL SPECIFICATIONS (FS)

FS AA-V-00200 (Rev B) Venetian Blinds

NATIONAL FIRE PROTECTION (NFPA)

NFPA 701 (1996) Methods of Fire Tests for Flame-Resistant Textiles and Films

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with SECTION: SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Approved Detail Drawings; G

Drawings showing fabrication and installation details. Drawings shall show layout and locations of track, direction of draw, mounting heights, and details.

SD-03 Product Data

Window Blinds; G, A/S
Hardware; G, A/S

Manufacturer's data composed of catalog cuts, brochures, product information, and maintenance instructions.

SD-04 Samples

Window Treatments; G, A/S

Three samples of each type and color of window treatment. Blind slats or louvers shall be 150 mm in length for each color. Track shall be 150 mm in length.

1.3 GENERAL

Window blinds shall be provided, complete with necessary brackets, fittings, and hardware. Each blind shall be a complete unit provided in accordance with paragraph WINDOW BLIND SCHEDULE. Equipment shall be mounted and operated as indicated. Windows shall be completely covered. The Contractor shall take measurements at the building and shall be responsible for the proper fitting and hanging of the equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

Components shall be delivered to the job site in the manufacturer's original packaging with the brand or company name, item identification, and project reference clearly marked. Components shall be stored in a dry location that is adequately ventilated and free from dust, water, or other contaminants and shall have easy access for inspection and handling. Materials shall be stored flat in a clean dry area with temperature maintained above 10 degrees C.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 WARRANTY

Manufacturer's standard performance guarantees or warranties that extend beyond a 1 year period shall be provided.

1.7 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of window blinds with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of material delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 WINDOW BLINDS

Each blind, including hardware, accessory items, mounting brackets and fastenings, shall be provided as a complete unit produced by one manufacturer. All parts shall be one color

unless otherwise shown, and match the color of the blind slat. Steel features shall be treated for corrosion resistance.

2.1.1 Horizontal Blinds

Horizontal blinds shall conform to FS AA-V-00200, Type II (25 mm slats), except as modified below. Blind units shall be capable of nominally 180 degree partial tilting operation and full-height raising. Blinds shall be inside mount as shown.

2.1.1.1 Head Channel and Slats

Head channel shall be aluminum nominal 0.61 mm for Type II with half crowned profile and provision for prevention of light leakage. Design of unit shall be valance free. Slats shall be aluminum, not less than 0.203 mm thick, and of sufficient strength to prevent sag or bow in the finished blind. Distance between slats shall not exceed 19.6 mm. A sufficient amount of slats shall be provided to assure proper control, uniform spacing, and adequate overlap. Installation brackets shall be completely concealed type.

2.1.1.2 Controls

The slats shall be tilted by a transparent tilting wand, hung vertically by its own weight, and shall swivel for easy operation. The tilter control shall be of enclosed construction. Moving parts and mechanical drive shall be made of compatible materials which do not require lubrication during normal expected life. Tilter mechanism shall be a worm gear drive with automatic disengagement to prevent overdriving. The tilter shall tilt the slats to any desired angle and hold them at that angle so that any vibration or movement of ladders and slats will not drive the tilter and change the angle of slats. A mechanism shall be included to prevent over tightening. The wand shall be of sufficient length to reach to within 1500 mm of the floor. For all windows that have a head height greater than 3000 mm, or where the wand cannot hang vertically due to obstruction, provide a heavy duty removable wand extension that will provide easy operation of the controls. Each room with windows requiring wands of this type shall be supplied with a wand and a wall mount for the wand.

2.1.1.3 Intermediate Brackets

Intermediate brackets shall be provided for installation of blinds over 1200 mm wide and shall be installed as recommended by the manufacturer.

2.1.1.4 Hold-Down Brackets

Universal type hold-down brackets for sill or jamb mount shall be provided and installed at locations where adjacent pedestrian traffic or doors are likely to cause movement of the blinds.

2.2 COLOR

Color shall be as indicated on drawings. Where no color is indicated, provide manufacturer's full range of colors for selection.

PART 3 EXECUTION

3.1 WINDOW BLIND PLACEMENT SCHEDULE

Horizontal blinds shall be provided at all exterior windows at Barracks, Soldier Community Building, Battalion Headquarters, Medium and Large Company Operations Building, with the following exceptions:

- a) not required at corridor windows in Barracks or SCB.
- b) not required at glazing in exterior doors.

Provide horizontal blinds at all interior window locations as indicated on drawings.

3.2 INSTALLATION

Installation shall be in accordance with the approved detail drawings and manufacturer's installation instructions. Units shall be level, plumb, secure, and at proper height and location relative to window units. The Contractor shall furnish and install supplementary or miscellaneous items in total, including clips, brackets, or anchorages incidental to or necessary for a sound, secure, and complete installation. Installation shall not be initiated until completion of room painting, completion of carpet installation and finishing operations.

3.3 PROTECTION AND CLEANING

Upon completion of the installation, window blinds shall be adjusted for form and appearance, shall be in proper operating condition, and shall be free from damage or blemishes. Damaged and malfunctioning units shall be repaired or replaced by the Contractor as directed by the Contracting Officer. If construction operations subsequent to blind installation cause contamination of the blinds of any nature from any source, blinds shall be cleaned as recommended in writing by the manufacturer.

END OF SECTION

SECTION 13080

SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 53	(1999) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 307	(1997) Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength
ASTM A 325	(1997) Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A 325M	(1997) High-Strength Bolts for Structural Steel Joints (Metric)
ASTM A 500	(1999) Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A 563	(1997) Carbon and Alloy Steel Nuts
ASTM A 572/A 572M	(1999) High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A 603	(1998) Zinc-Coated Steel Structural Wire Rope
ASTM A 653/A 653M	(1999) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM E 488	(1996) Strength of Anchors in Concrete and Masonry Elements

ASME INTERNATIONAL(ASME)

ASME B18.2.1	(1996) Square and Hex Bolts and Screws (Inch Series)
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ASME B18.2.2 (1987; R 1999) Square and Hex Nuts (Inch Series)

CORPS OF ENGINEERS, HUNTSVILLE CENTER (CEHNC)

TI 809-04 (1998) Seismic Design for Buildings

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems outlined in Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT, the electrical equipment and systems outlined in Section 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT, and the miscellaneous equipment and systems listed below. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads.

1.2.2 Miscellaneous Equipment and Systems

The bracing for the following miscellaneous equipment and systems shall be developed by the Contractor in accordance with the requirements of this specification:

Storage cabinets	Ornamentations
Storage Racks	Signs and Billboards
Shelving	Furnishings
Partitions	

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Bracing ; Resilient Vibration Isolation Devices ; Equipment Requirements ; G

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction. For equipment and systems in buildings that have a performance objective higher than life-safety, the drawings shall be stamped by the registered engineer who stamps the calculations required above.

SD-03 Product Data

Bracing ; G Equipment Requirements ; G

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

Rigidly mounted equipment shall be constructed and assembled to resist a horizontal lateral force of 0.52 times the operating weight of the equipment. For any rigid equipment which is rigidly attached on both sides of a building expansion joint, flexible joints for piping, electrical conduit, etc., that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions, shall be provided.

1.4.2 Nonrigid or Flexibly-Mounted Equipment

Nonrigid or flexibly mounted equipment shall be constructed and assembled to resist a horizontal lateral force of 1.32 times the operating weight of the equipment at the vertical center of gravity of the equipment.

PART 2 PRODUCTS

2.1 BOLTS AND NUTS

Squarehead and hexhead bolts, and heavy hexagon nuts, ASME B18.2.1, ASME B18.2.2, or ASTM A 307 for bolts and ASTM A 563 for nuts. ASTM A 325M (ASTM A 325) for bolts and nuts. Bolts and nuts used underground and/or exposed to weather shall be galvanized in accordance with ASTM A 153/A 153M.

2.2 SWAY BRACING

Material used for members listed in this section and/or on the drawings, shall be structural steel conforming with the following:

- a. Plates, rods, and rolled shapes, ASTM A 36/A 36M, ASTM A 572/A 572M, Grade 503.
- b. Wire rope, ASTM A 603.
- c. Tubes, ASTM A 500, Grade B.
- d. Pipes, ASTM A 53, Type E or S, Grade B.
- e. Light gauge angles, less than 6 mm(1/4 inch) thickness, ASTM A 653/A 653M.

PART 3 EXECUTION

3.1 BRACING

Bracing shall conform to the arrangements shown. Trapeze-type hanger shall be secured with not less than two 13 mm (1/2 inch) bolts.

3.2 BUILDING DRIFT

Sway braces for a piping run shall not be attached to two dissimilar structural elements of a building that may respond differentially during an earthquake unless a flexible joint is provided.

3.3 ANCHOR BOLTS

3.3.1 Cast-In-Place

Floor or pad mounted equipment shall use cast-in-place anchor bolts, except as specified below. Anchor bolts shall conform to ASTM A 307. Anchor bolts shall have an embedded straight length equal to at least 12 times nominal diameter of the bolt. Anchor bolts that exceed the normal depth of equipment foundation piers or pads shall either extend into concrete floor or the foundation shall be increased in depth to accommodate bolt lengths.

3.3.2 Expansion or Chemically Bonded Anchors

Expansion or chemically bonded anchors shall not be used unless test data in accordance with ASTM E 488 has been provided to verify the adequacy of the specific anchor and application. Expansion or chemically bonded anchors shall not be used to resist pull-out in overhead and wall installations if the adhesive is manufactured with temperature sensitive epoxies and the location is accessible to a building fire. Expansion and chemically bonded anchors shall be installed in accordance with the manufacturer's recommendations. The allowable forces shall be adjusted for the spacing between anchor bolts and the distance between the anchor bolt and the nearest edge, as specified by the manufacturer.

3.3.2.1 General Testing

Expansion and chemically bonded anchors shall be tested in place after installation. The tests shall occur not more than 24 hours after installation of the anchor and shall be conducted by an independent testing agency; testing shall be performed on random anchor bolts as described below.

3.3.2.2 Torque Wrench Testing

Torque wrench testing shall be done on not less than 50 percent of the total installed expansion anchors and at least one anchor for every piece of equipment containing more than two anchors. The test torque shall equal the minimum required installation torque as required by the bolt manufacturer. Torque wrenches shall be calibrated at the beginning of each day the torque tests are performed. Torque wrenches shall be recalibrated for each bolt diameter whenever tests are run on bolts of various diameters. The applied torque shall be between 20 and 100 percent of wrench capacity. The test torque shall be reached within one half turn of the nut, except for 9 mm (3/8 inch) sleeve anchors which shall reach their torque

by one quarter turn of the nut. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified torque; if the anchor still fails the test it shall be replaced.

3.3.2.3 Pullout Testing

Expansion and chemically bonded anchors shall be tested by applying a pullout load using a hydraulic ram attached to the anchor bolt. At least 5 percent of the anchors, but not less than 3 per day shall be tested. The load shall be applied to the anchor without removing the nut; when that is not possible, the nut shall be removed and a threaded coupler shall be installed of the same tightness as the original nut. The test setup shall be checked to verify that the anchor is not restrained from withdrawing by the baseplate, the test fixture, or any other fixtures. The support for the testing apparatus shall be at least 1.5 times the embedment length away from the bolt being tested. Each tested anchor shall be loaded to 1 times the design tension value for the anchor. The anchor shall have no observable movement at the test load. If any anchor fails the test, similar anchors not previously tested shall be tested until 20 consecutive anchors pass. Failed anchors shall be retightened and retested to the specified load; if the anchor still fails the test it shall be replaced.

3.4 RESILIENT VIBRATION ISOLATION DEVICES

Where the need for these devices is determined, based on the magnitude of the design seismic forces, selection of anchor bolts for vibration isolation devices and/or snubbers for equipment base and foundations shall follow the same procedure as in paragraph ANCHOR BOLTS, except that an equipment weight equal to five times the actual equipment weight shall be used.

3.4.1 Resilient and Spring-Type Vibration Devices

Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 13 mm (0.5 inches).

3.4.2 Multidirectional Seismic Snubbers

Multidirectional seismic snubbers employing elastomeric pads shall be installed on floor- or slab-mounted equipment. These snubbers shall provide 6 mm (0.25 inches) free vertical and horizontal movement from the static deflection point. Snubber medium shall consist of multiple pads of cotton duct and neoprene or other suitable materials arranged around a flanged steel trunnion so both horizontal and vertical forces are resisted by the snubber medium.

3.5 SWAY BRACES FOR PIPING

Transverse sway bracing for steel and copper pipe shall be provided at intervals not to exceed those shown on the drawings. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400 PLUMBING, GENERAL PURPOSE. Bracing shall consist of at least one vertical angle 50 x 50 mm x 16 gauge (2 x 2 x 16 gauge) and one diagonal angle of the same size.

3.5.1 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided in accordance with Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.5.2 Anchor Rods, Angles, and Bars

Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as specified below. Anchor rods, angles, and bars shall not exceed lengths given in the tabulation below.

3.5.3 Maximum Length for Anchor Braces

Type	Size (millimeters)	Maximum Length* (meters)
Angles	38 x 38 x 6	1.5
	50 x 50 x 6	2.0
	64 x 38 x 6	2.5
	75 x 64 x 6	2.5
	75 x 75 x 6	3.0
Rods	91	1.0
	22	1.0
Flat Bars	38 x 6	0.4
	50 x 6	0.4
	50 x 10	0.5
Pipes (40s)	25	2.0
	32	2.8
	40	3.2
	50	4.0
Type	Size (inches)	Max Length ft-in
Angles	1-1/2 x 1-1/2 x 1/4	4-10
	2 x 2 x 1/4	6-6
	2-1/2 x 1-1/2 x 1/4	8-0
	3 x 2-1/2 x 1/4	8-10
	3 x 3 x 1/4	9-10
Rods	3/4	3-1
	7/8	3-8
Flat Bars	1-1/2 x 1/4	1-2
	2 x 1/4	1-2
	2 x 3/8	1-9
Pipes (40S)	1	7-0
	1-1/4	9-0
	1-1/2	10-4
	2	13-1

3.5.4 Bolts

Bolts used for attachment of anchors to pipe and structure shall be not less than 13 mm (1/2 inch) diameter.

3.6 EQUIPMENT SWAY BRACING

3.6.1 Suspended Equipment and Light Fixtures

Equipment sway bracing shall be provided for items supported from overhead floor or roof structural systems, including light fixtures. Braces shall consist of angles, rods, wire rope, bars, or pipes arranged as shown and secured at both ends with not less than 13 mm (1/2 inch) bolts. Sufficient braces shall be provided for equipment to resist a horizontal force equal to 1.5 times the weight of equipment without exceeding safe working stress of bracing components. Details of equipment bracing shall be submitted for acceptance. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.

3.6.2 Floor or Pad Mounted Equipment

3.6.2.1 Shear Resistance

Floor mounted equipment shall be bolted to the floor. Requirements for the number and installation of bolts to resist shear forces shall be in accordance with paragraph ANCHOR BOLTS.

3.6.2.2 Overturning Resistance

The ratio of the overturning moment from seismic forces to the resisting moment due to gravity loads shall be used to determine if overturning forces need to be considered in the sizing of anchor bolts. Calculations shall be provided to verify the adequacy of the anchor bolts for combined shear and overturning.

3.7 SPECIAL INSPECTION AND TESTING FOR SEISMIC-RESISTING SYSTEMS

Special inspections and testing for seismic-resisting systems and components shall be done in accordance with Section 01452 SPECIAL INSPECTION FOR SEISMIC-RESISTING SYSTEMS.

END OF SECTION

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SECTION 13721

SMALL INTRUSION DETECTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI X3.92	(1981; R 1993) Data Encryption Algorithm
ANSI X3.154	(1988; R 1994) Office Machines and Supplies - Alphanumeric Machines-Keyboards Arrangement

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15	Radio Frequency Devices
47 CFR 68	Connection of Terminal Equipment to the Telephone Network

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

EIA ANSI/EIA/TIA-232-F	(1997) Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 100	(1997) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 142	(1991) IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems

INTERNATIONAL TELECOMMUNICATION UNION (ITU)

ITU V.34	(1994) Data Communication Over the Telephone Network A Modem Operating at Data Signaling Rates of up to 28,000 bits for use on the General Switched Telephone Network and on Leased Point-to-Point Two-Wire Telephone Type Circuits
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ITU V.42	(1993) Data Communications Over the Telephone Network Error-Correcting Procedures for DCEs Using Asynchronous-to-Synchronous Conversion
ITU V.42 bis	(1990) Data Compression Procedures for Data Circuit Terminating Equipment (DCE) Using Error Correction Procedures

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 294	(1999) Access Control System Units
UL 639	(1997; Rev thru Mar 1999) Intrusion Detection Units
UL 681	(1999) Installation and Classification of Burglar and Holdup Alarm Systems
UL 796	(1999) Printed-Wiring Boards
UL 1037	(1999) Antitheft Alarms and Devices
UL 1076	(1995; Rev thru Feb 1999) Proprietary Burglar Alarm Units and Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General

The Contractor shall configure the Intrusion Detection System (IDS) as described and shown, including Government Furnished Equipment (GFE). Computing devices, as defined in 47 CFR 15, shall be certified to comply with the requirements for Class A computing devices and labeled as set forth in 47 CFR 15.

The Contractor shall provide an intrusion detection system extension of the existing system at Ft Lewis. The components required consist of balanced magnetic door switches, passive infrared detectors (PIR), tamper switches, keypads, duress alarms, and Integrated Commercial Intrusion Detection System (ICIDS) Monitor Dynamics Inc. (MDI) Remote Terminal Unit (RTU-195) series local processors and preprocessing unit (PPU-50 or 100) as required.

1.2.2 Electrical Requirements

Electrically powered IDS equipment shall operate on 120 or 240 volt 60 Hz AC sources as shown. Equipment shall be able to tolerate variations in the voltage source of plus or minus 10 percent, and variations in the line frequency of plus or minus 2 percent with no degradation of performance.

1.2.3 Power Line Surge Protection

Equipment connected to alternating current circuits shall be protected from power line surges. Equipment protection shall withstand surge test waveforms described in IEEE C62.41. Fuses shall not be used for surge protection.

1.2.4 Sensor Wiring and Communication Circuit Surge Protection

Inputs shall be protected against surges induced on sensor wiring. Outputs shall be protected against surges induced on control and sensor wiring installed outdoors and as shown. All communications equipment shall be protected against surges induced on any communications circuit. All cables and conductors, except fiber optics, which serve as communications circuits from the console to field equipment, and between field equipment, shall have surge protection circuits installed at each end. Protection shall be furnished at equipment, and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 900 mm (3 feet) of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An 8 microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

1.2.5 Environmental Conditions

1.2.5.1 Interior, Controlled Environment

All system components, except the console, installed in interior locations having controlled environments shall be rated for continuous operation under ambient environmental conditions of 2 to 50 degrees C (36 to 122 degrees F) dry bulb and 20 to 90 percent relative humidity, noncondensing.

1.2.5.2 Interior, Uncontrolled Environment

All system components installed in interior locations having uncontrolled environments shall be rated for continuous operation under ambient environmental conditions of minus 18 to plus 50 degrees C (0 to 122 degrees F) dry bulb and 10 to 95 percent relative humidity, noncondensing.

1.2.5.3 Exterior Environment

System components that are installed in locations exposed to weather shall be rated for continuous operation under ambient environmental conditions of minus 34 degrees to 50 degrees C (minus 30 to 122 degrees F) dry bulb and 10 to 95 percent relative humidity, condensing. In addition, the system components shall be rated for continuous operation when exposed to performance conditions as specified in UL 294 and UL 639 for outdoor use equipment. In addition, components shall be rated

for continuous operation when exposed to rain as specified in NEMA 250, winds up to 137 km per hr (85 mph) and snow cover up to 610 mm(2 feet) thick, measured vertically.

1.2.5.4 Hazardous Environment

System components located in areas where fire or explosion hazards may exist because of flammable gases or vapors, flammable liquids, combustible dust, or ignitable fibers or flyings, shall be rated and installed according to Chapter 5 of NFPA 70 and as shown.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Intrusion Detection System ; G

- a. System block diagram.
- b. Console installation, block diagrams, and wiring diagrams.
- c. Processor installation, typical block, and wiring diagrams.
- d. Details of connections to power sources, including power supplies and grounding.
- e. Details of surge protection device installation.
- f. Sensor detection patterns.
- g. The qualifications of the Manufacturer, Contractor, and Installer to perform the work specified herein.

Spare Parts ;

Data lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings and not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended for stocking.

Manufacturer's Instructions ; G

Printed copies of manufacturer's recommendations for installation of materials prior to installation. Where installation procedures, or any part thereof, are required to be in accordance with manufacturer's recommendations, installation of the item will not be allowed to proceed until the recommendations are received and approved.

Testing ; G

Test plan defining all tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Experience ; G

Written proof of specified experience requirements.
Civilian contractor employees must possess a minimum security clearance of CONFIDENTIAL, granted in accordance with AR 380-67, paragraph 3-400.

SD-06 Test Reports

Performance Verification Test ; G

Test reports, in booklet form with witness signatures verifying execution of tests. Reports shall show the field tests to verify compliance with the specified performance criteria. Test reports shall include records of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

Materials and Equipment ;

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

1.4 TESTING

The Contractor shall perform site testing and adjustment of the completed intrusion detection system. The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all testing. Written notification of planned testing shall be given to the Government at least 14 days prior to the test, and in no case shall notice be given until after the Contractor has received written approval of the specific test procedures.

1.5 LINE SUPERVISION

1.5.1 Signal and Data Transmission System (DTS) Line Supervision

All signal or DTS lines between sensors and the alarm annunciation console shall be supervised by the system. The system shall supervise the signal lines by monitoring changes in the direct current that flows through the signal lines and a terminating resistor. The system shall initiate an alarm in response to a current change of 10 percent or greater. The system shall also initiate an alarm in response to opening, closing, shorting, or grounding of the signal and DTS lines.

1.5.2 Data Encryption

The intrusion detection system shall incorporate data encryption equipment on data transmission media links as shown. The algorithm used for encryption shall be the Data Encryption Standard (DES) algorithm described in ANSI X3.92.

1.6 EXPERIENCE

The Contractor shall submit written proof that the following experience requirements are being met.

1.6.1 System Installer

The system shall be installed by a contractor who has been regularly engaged in the installation of intrusion detection systems of similar type and complexity as the specified system for at least 2 years.

Civilian contractor employees must possess a minimum security clearance of CONFIDENTIAL, granted in accordance with AR 380-67, paragraph 3-400.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

2.1.1 Materials and Equipment

Units of the same type of equipment shall be products of a single manufacturer. All material and equipment shall be new and currently in production. Each major component of equipment shall have the manufacturer's model and serial number in a conspicuous place.

2.1.2 Enclosures

System enclosures shall be as shown.

2.1.2.1 Interior Sensor

Sensors to be used in an interior environment shall be housed in an enclosure that provides protection against dust, falling dirt, and dripping noncorrosive liquids.

2.1.2.2 Interior Electronics

System electronics to be used in an interior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 12.

2.1.2.3 Exterior Electronics

System electronics to be used in an exterior environment shall be housed in enclosures which meet the requirements of NEMA 250 Type 4X.

2.1.2.4 Corrosion Resistant

System electronics to be used in a corrosive environment as defined in NEMA 250 shall be housed in an enclosure which meet the requirements of NEMA 250 Type 4X.

2.1.2.5 Hazardous Environment Equipment

System electronics to be used in a hazardous environment shall be housed in an enclosure which meets the requirements of paragraph Hazardous Environment.

2.1.3 Nameplates

Laminated plastic nameplates shall be provided for local processors. Each nameplate shall identify the local processor and its location within the system. Laminated plastic shall be 3 mm (1/8 inch) thick, white with black center core. Nameplates shall be a minimum of 25 by 75 mm, (1 by 3 inches,) with minimum 6 mm (1/4 inch) high engraved block lettering. Nameplates shall be attached to the inside of the enclosure housing the local processor. Other major components of the system shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a corrosion resistant plate secured to the item of equipment. Nameplates will not be required for devices smaller than 25 by 75 mm. (1 by 3 inches.)

2.1.4 Fungus Treatment

System components located in fungus growth inductive environments shall be completely treated for fungus resistance. Treating materials containing a mercury bearing fungicide shall not be used. Treating materials shall not increase the flammability of the material or surface being treated. Treating materials shall cause no skin irritation or other injury to personnel handling it during fabrication, transportation, operation, or maintenance of the equipment, or during use of the finished items when used for the purpose intended.

2.1.5 Tamper Provisions

2.1.5.1 Tamper Switches

Enclosures, cabinets, housings, boxes, and fittings of every description having hinged doors or removable covers and which contain circuits or connections of the intrusion detection system and its power supplies, shall be provided with cover operated, corrosion-resistant tamper switches, arranged to initiate an alarm signal when the door or cover is moved. The enclosure and the tamper switch shall function together in such a manner as to not allow direct line of sight to any internal components before the switch activates. Tamper switches shall be inaccessible until the switch is activated; have mounting hardware so concealed that the location of the switch cannot be observed from the exterior of the enclosure; be connected to circuits which are under electrical supervision at all times, irrespective of the protection mode in which the circuit is operating; shall be spring-loaded and held in the closed position by the door or cover; and shall be wired so that they break the circuit when the door or cover is disturbed.

- a. Nonsensor Enclosures: Tamper switches on nonsensor enclosures, which must be opened to make routine maintenance adjustments to the system and to service the power supplies, shall be push/pull-set, automatic reset type.

- b. Sensor Enclosures: Tamper switches on sensor enclosures, which must be opened to make routine maintenance adjustments to the sensor, shall be single pole single throw type.

2.1.5.2 Enclosure Covers

Covers of pull and junction boxes provided to facilitate initial installation of the system need not be provided with tamper switches if they contain no splices or connections, but shall be protected by tack welding or brazing the covers in place or by tamper resistant security fasteners. Labels shall be affixed to such boxes indicating they contain no connections.

2.1.6 Application of System Component

System components shall be designed for continuous operation. Electronic components shall be solid state type, mounted on printed circuit boards conforming to UL 796. Printed circuit board connectors shall be plug-in, quick-disconnect type. Power dissipating components shall incorporate safety margins of not less than 25 percent with respect to dissipation ratings, maximum voltages, and current carrying capacity. Light duty relays and similar switching devices shall be solid state type or sealed electro-mechanical.

2.1.6.1 Maintainability

Components shall be designed to be maintained using commercially available tools and equipment. Components shall be arranged and assembled so they are accessible to maintenance personnel. There shall be no degradation in tamper protection, structural integrity, EMI/RFI attenuation, or line supervision after maintenance when it is performed in accordance with manufacturer's instructions. The system shall be configured and installed to yield a mean time to repair (MTTR) of not more than 8 hours. Repair time is the clock time from the time maintenance personnel are given entrance to the system and begin work, until the system is fully functional.

2.1.6.2 Interchangeability

The system shall be constructed with off-the-shelf components which are physically, electrically and functionally interchangeable with equivalent components as complete items. Replacement of equivalent components shall not require modification of either the new component or of other components with which the replacement items are used. Custom designed or one-of-a-kind items shall not be used. Interchangeable components or modules shall not require trial and error matching in order to meet integrated system requirements, system accuracy, or restore complete system functionality.

2.1.6.3 Product Safety

System components shall conform to applicable rules and requirements of NFPA 70. System components shall be equipped with instruction plates, including warnings and cautions, describing physical safety, and special or important procedures to be followed in operating and servicing system equipment.

2.1.7 Controls and Designations

Controls and designations shall be as specified in NEMA ICS 1.

2.1.8 Special Test Equipment

The Contractor shall provide all special test equipment, special hardware, software, tools, and programming or initialization equipment needed to start or maintain any part of the system and its components. Special test equipment is defined as any test equipment not normally used in an electronics maintenance facility.

2.1.9 Alarm Output

The alarm output of each sensor shall be a single pole double throw (SPDT) contact rated for a minimum of 0.25 A at 24 volts DC.

2.1.10 Access/Secure Devices

Access/secure devices shall be used to place a protected zone in ACCESS. The device shall disable all sensor alarm outputs, with the exception of tamper alarm outputs within the protected zone, and sensors in zones above false ceilings or other inaccessible locations as shown.

2.1.10.1 Switches

The switch shall consist of a double pull key-operated switch housed in a NEMA 12 equivalent enclosure.

2.1.10.2 Key Pads

Secure/Access keypads shall use a unique combination of alphanumeric and other symbols as an identifier. Keypads shall contain an integral alphanumeric/special symbols keyboard with symbols arranged in ascending ASCII code ordinal sequence. The keypad shall have a contact output.

2.2 INTERIOR SENSORS

2.2.1 Balanced Magnetic Switch (BMS)

The BMS shall detect 6 mm (1/4 inch) of separating relative movement between the magnet and the switch housing. Upon detecting such movement, it shall transmit an alarm signal to the alarm annunciation system.

2.2.1.1 BMS Subassemblies

The BMS shall consist of a switch assembly and an actuating magnetic assembly. The switch mechanism shall be of the balanced magnetic type. Each switch shall be provided with an overcurrent protective device, rated to limit current to 80 percent of the switch capacity. Switches shall be rated for a minimum lifetime of one million operations. The housings of surface mounted switches and magnets shall be made of nonferrous metal and shall be weatherproof. The housings of recess mounted switches and magnets shall be made of nonferrous metal or plastic.

2.2.1.2 Remote Test

A remote test capability shall be provided. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall activate the sensor's switch mechanism

causing an alarm signal to be transmitted to the alarm annunciation system. The remote test shall simulate the movement of the actuating magnet relative to the switch subassembly.

2.2.2 Duress Alarm Switches

Duress alarm switches shall provide the means for an individual to covertly notify the alarm annunciation system that a duress situation exists.

2.2.2.1 Pushbutton

Latching pushbutton duress alarms shall be designed to be activated by depressing a pushbutton located on the duress switch housing. No visible or audible alarm or noise shall emanate from the switch. The switch shall lock in the activated position until manually reset with a key. The switch housing shall shroud the activating button to prevent accidental activation. Switches shall be rated for a minimum lifetime of 50,000 operations.

2.2.3 Passive Infrared Motion Sensor

The passive infrared motion sensor shall detect changes in the ambient level of infrared emissions caused by the movement of a standard intruder within the sensor's field of view. Upon detecting such changes, the sensor shall transmit an alarm signal to the alarm annunciation system. The sensor shall detect a change in temperature of no more than 1.1 degrees C, (2 degrees F,) and shall detect a standard intruder traveling within the sensor's detection pattern at a speed of 0.091 to 2.29 m (0.3 to 7.5 feet) per second across two adjacent segments of the field of view. Emissions monitored by the sensor shall be in the 8 to 14 micron range. The sensor shall be adjustable to obtain the coverage pattern shown. The sensor shall be equipped with a temperature compensation circuit.

2.2.3.1 Test Indicator, Infrared Emissions

The passive infrared motion sensor shall be equipped with an LED walk test indicator. The walk test indicator shall not be visible during normal operations. When visible, the walk test indicator shall light when the sensor detects an intruder. The sensor shall either be equipped with a manual control, located within the sensor's housing, to enable/disable the test indicator or the test indicator shall be located within the sensor such that it can only be seen when the housing is open/removed.

2.2.3.2 Remote Test, Infrared Emissions

A remote test capability shall be provided. The remote test hardware may be integral to the sensor or a separate piece of equipment. The remote test shall be initiated when commanded by the alarm annunciation system. The remote test shall excite the sensing element and associated electronics causing an alarm signal to be transmitted to the alarm annunciation system. The sensor stimulation generated by the remote test hardware shall simulate a standard intruder moving within the sensor's detection pattern.

2.3 SOFTWARE

The software shall support all specified functions. The central station shall be online at all times and shall perform all required functions. Software shall be resident at the central station and/or the local processor as required to perform all specified functions.

2.3.1 System Software

The operating system of the existing system is Ultrak O/S 2 SafeNet. New products shall be fully compatible with the existing system.

2.4 FIELD PROCESSING HARDWARE

2.4.1 Alarm Annunciation Local Processor

The alarm annunciation local processor shall respond to interrogations from the field device network, recognize and store alarm status inputs until they are transmitted to the central station and change outputs based on commands received from the central station. The local processor shall also automatically restore communication within 10 seconds after an interruption with the field device network and provide dc line supervision on each of its alarm inputs. The processor shall be Ultrak MDI RTU 195 operating Ultrak SafeNet under OS2 operating system.

2.4.2 Processor Power Supply

Local processor and sensors shall be powered from an uninterruptible power source. The uninterruptible power source shall provide 6 hours of battery back-up power in the event of primary power failure and shall automatically fully recharge the batteries within 12 hours after primary power is restored. There will be no equipment malfunctions or perturbations or loss of data during the switch from primary to battery power and vice versa. Batteries shall be sealed, non-outgassing type. The power supply shall be equipped with an indicator for ac input power and an indicator for dc output power. Loss of primary power shall be reported to the central station as an alarm.

2.4.3 Auxiliary Equipment Power

A GFI service outlet shall be furnished inside the local processor's enclosure.

2.5 FIELD PROCESSING SOFTWARE

All field processing software described in this specification shall be furnished as part of the complete system.

2.6 WIRE AND CABLE

2.6.1 General

The Contractor shall provide all wire and cable not indicated as Government furnished equipment. All wiring shall meet NFPA 70 standards.

2.6.2 Above Ground Sensor Wiring

Sensor wiring shall be 20 AWG minimum, twisted and shielded, 2, 3, 4, or 6 pairs to match hardware. Multiconductor wire shall have an outer jacket of PVC.

2.6.3 Class 2 Low Energy Conductors

The conductor sizes specified for digital functions shall take precedence over any requirements for Class 2 low energy signal-circuit conductors specified elsewhere.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

The Contractor shall install all system components, including Government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2 and as shown, and shall furnish necessary interconnections, services, and adjustments required for a complete and operable system as specified and shown. Final software programming for new equipment and final connections to the existing central station shall be performed by the Ft Lewis IDS maintenance contractor; the Contractor will not be permitted access to the Ft Lewis central equipment. (POC for maintenance contractor, Lockheed Martin, is TJ Petersen (253-966-6946)).

3.1.1 Installation

The Contractor shall install the system in accordance with the standards for safety, NFPA 70, UL 681, UL 1037 and UL 1076, and the appropriate installation manual for each equipment type. Components within the system shall be configured with appropriate service points to pinpoint system trouble in less than 20 minutes. Minimum size of conduit shall be 16 mm. (1/2 inch.) DTS shall not be pulled into conduits or placed in raceways, compartments, outlet boxes, junction boxes, or similar fittings with other building wiring. Flexible cords or cord connections shall not be used to supply power to any components of the system, except where specifically noted herein. All other electrical work shall be as specified in Sections 16415 and as shown. Grounding shall be installed as necessary to preclude ground loops, noise, and surges from adversely affecting system operation.

3.1.2 Enclosure Penetrations

All enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and all penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.1.3 Cold Galvanizing

All field welds and/or brazing on factory galvanized components, such as boxes, enclosures, and conduits, shall be coated with a cold-galvanized paint containing at least 95 percent zinc by weight.

3.2 SYSTEM STARTUP

The Contractor shall not apply power to the intrusion detection system until the following items have been completed:

- a. Intrusion detection system equipment items and DTS have been set up in accordance with manufacturer's instructions.
- b. A visual inspection of the intrusion detection system has been conducted to ensure that defective equipment items have not been installed and that there are no loose connections.

- c. System wiring has been tested and verified as correctly connected as indicated.
- d. All system grounding and transient protection systems have been verified as properly installed and connected as indicated.
- e. Power supplies to be connected to the intrusion detection system have been verified as the correct voltage, phasing, and frequency as indicated.
- f. Satisfaction of the above requirements shall not relieve the Contractor of responsibility for incorrect installation, defective equipment items, or collateral damage as a result of Contractor work/equipment.

3.3 SITE TESTING

3.3.1 General

The Contractor shall provide personnel, equipment, instrumentation, and supplies necessary to perform the site testing. The Government will witness all testing. Written permission shall be obtained from the Government before proceeding with the next phase of testing. Original copies of all data produced during performance verification and endurance testing shall be turned over to the Government at the conclusion of each phase of testing prior to Government approval of the test.

3.3.2 Contractor's Field Testing

The Contractor shall calibrate and test all equipment, verify data transmission system (DTS) operation, place the integrated system in service, and test the integrated system. Ground rods installed by the Contractor shall be tested as specified in IEEE Std 142. The Contractor shall deliver a report describing results of functional tests, diagnostics, and calibrations including written certification to the Government that the installed complete system has been calibrated, tested, and is ready to begin performance verification testing. The report shall also include a copy of the approved performance verification test procedure.

3.3.3 Performance Verification Test

The Contractor shall demonstrate that the completed system complies with the specified requirements. Using approved test procedures, all physical and functional requirements of the project shall be demonstrated and shown. The performance verification test, as specified, shall not be started until receipt by the Contractor of written permission from the Government, based on the Contractor's written request. This shall include certification of successful completion of testing as specified in paragraph Contractor's Field Testing, and upon successful completion of training as specified. Upon successful completion of the performance verification test, the Contractor shall deliver test reports and other documentation to the Government, as specified. The Contractor will not be held responsible for failures in system performance resulting from the following:

- (1) An outage of the main power in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished and that automatic shutdown and restart of the system performed as specified.
- (2) Failure of a Government furnished communications link, provided that the failure was not due to Contractor furnished equipment, installation, or software.

- (3) Failure of existing Government owned equipment, provided that the failure was not due to Contractor furnished equipment, installation, or software.
- (4) The occurrence of specified nuisance alarms.
- (5) The occurrence of specified environmental alarms.

END OF SECTION

SECTION 13851

FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S3.41 (1990; R 1996) Audible Emergency Evacuation Signals

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 15 Radio Frequency Devices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C62.41 (1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

NFPA 72 (1999) National Fire Alarm Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating Systems

NFPA 1221 (1994) Installation, Maintenance and Use of Public Fire Service Communication Systems

UNDERWRITERS LABORATORIES (UL)

UL 6 (1997) Rigid Metal Conduit

UL 38 (1994; Rev Nov 1994) Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems

UL 228 (1997; Rev Jan 1999) Door Closers-Holders, With or Without Integral Smoke Detectors

UL 268	(1996; Rev through Jun 1999) Smoke Detectors for Fire Protective Signaling Systems
UL 268A	(1998) Smoke Detectors for Duct Applications
UL 464	(1996; Rev May 1999) Audible Signal Appliances
UL 521	(1999) Heat Detectors for Fire Protective Signaling Systems
UL 632	(2000) Electrically-Actuated Transmitters
UL 797	(1993; Rev through Mar 1997) Electrical Metallic Tubing
UL 864	(1996; Rev through Mar 1999) Control Units for Fire-Protective Signaling Systems
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1971	(1995; Rev through May 1997) Signaling Devices for the Hearing Impaired

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Fire Alarm Reporting System; G

Detail drawings, prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, catalog cuts, and installation instructions. Note that the contract drawings show layouts based on typical detectors. The Contractor shall check the layout based on the actual detectors to be installed and make any necessary revisions in the detail drawings. The detail drawings shall also contain complete wiring and schematic diagrams, including field assigned identification addresses, for the equipment furnished, equipment layout, and any other details required to demonstrate that the system has been coordinated and will properly function as a unit. Detailed point-to-point wiring diagram shall be prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician showing points of connection. Diagram shall include connections between system devices, appliances, control panels, supervised devices, and equipment that is activated or controlled by the panel.

SD-03 Product Data

Storage Batteries;

Substantiating battery calculations for supervisory and alarm power requirements. Ampere-hour requirements for each system component and each panel component, and the battery recharging period shall be included.

Voltage Drop;

Voltage drop calculations for notification appliance circuits to indicate that sufficient voltage is available for proper appliance operation.

Special Tools and Spare Parts;

Spare parts data for each different item of material and equipment specified, not later than 3 months prior to the date of beneficial occupancy. Data shall include a complete list of parts and supplies with the current unit prices and source of supply and a list of the parts recommended by the manufacturer to be replaced after 1 year of service.

Technical Data and Computer Software; G

Technical data which relates to computer software.

Training; G

Lesson plans, operating instructions, maintenance procedures, and training data, furnished in manual format, for the training courses. The operations training shall familiarize designated government personnel with proper operation of the fire alarm system. The training course shall provide the designated government personnel adequate knowledge required to diagnose, repair, maintain, modify, and expand functions inherent to the system.

Testing

Detailed test procedures, prepared and signed by a Registered Professional Engineer or a NICET Level 3 or 4 Fire Alarm Technician, for the fire detection and alarm system 60 days prior to performing system tests.

SD-06 Test Reports

Testing

Test reports, in booklet form, showing field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall document readings, test results and indicate the final position of controls. The Contractor shall include the NFPA 72 Certificate of Completion and NFPA 72 Inspection and Testing Form, with the appropriate test reports.

SD-07 Certificates

Equipment; G

Certified copies of current approvals or listings issued by an independent test lab if not listed by UL, FM or other nationally recognized testing laboratory, showing compliance with specified NFPA standards.

Qualifications

Proof of qualifications for required personnel. The installer shall submit proof of experience for the Professional Engineer, fire alarm technician, and the installing company.

SD-10 Operation and Maintenance Data

Technical Data and Computer Software; G

Six copies of operating manual outlining step-by-step procedures required for system startup, operation, and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and complete description of equipment and their basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guide. The manuals shall include conduit layout, equipment layout and simplified wiring, and control diagrams of the system as installed. The manuals shall include complete procedures for system revision and expansion, detailing both equipment and software requirements. Original and backup copies of all software delivered for this project shall be provided, on each type of media utilized. Manuals shall be approved prior to training.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that can provide service within 24 hours of notification.

1.3.2 Nameplates

Major components of equipment shall have the manufacturer's name, address, type or style, voltage and current rating, and catalog number on a noncorrosive and nonheat-sensitive plate which is securely attached to the equipment.

1.3.3 Keys and Locks

Locks shall be keyed alike for "211" keys. Four keys for the system shall be provided.

1.3.4 Tags

Tags with stamped identification number shall be furnished for keys and locks.

1.3.5 Verification of Dimensions

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3.6 Compliance

The fire detection and alarm system and the central reporting system shall be configured in accordance with NFPA 72; exceptions are acceptable as directed by the Contracting Officer. The equipment furnished shall be compatible and be UL listed, FM approved, or approved or listed by a nationally recognized testing laboratory in accordance with the applicable NFPA standards.

1.3.7 Qualifications

1.3.7.1 Engineer and Technician

- a. Registered Professional Engineer with verification of experience and at least 4 years of current experience in the design of the fire protection and detection systems.
- b. National Institute for Certification in Engineering Technologies (NICET) qualifications as an engineering technician in fire alarm systems program with verification of experience and current NICET certificate.
- c. The Registered Professional Engineer may perform all required items under this specification. The NICET Fire Alarm Technician shall perform only the items allowed by the specific category of certification held.

1.3.7.2 Installer

The installing Contractor shall provide the following: Fire Alarm Technicians to perform the installation of the system. A Fire Alarm Technician with a minimum of 4 years of experience shall perform/supervise the installation of the fire alarm system. Fire Alarm Technicians with a minimum of 2 years of experience shall be utilized to assist in the installation and terminate fire alarm devices, cabinets and panels. An electrician shall be allowed to install wire or cable and to install conduit for the fire alarm system. The Fire Alarm technicians installing the equipment shall be factory trained in the installation, adjustment, testing, and operation of the equipment specified herein and on the drawings.

1.3.7.3 Design Services

Installations requiring designs or modifications of fire detection, fire alarm, or fire suppression systems shall require the services and review of a qualified fire protection engineer. For the purposes of meeting this requirement, a qualified fire protection engineer is defined as an individual meeting one of the following conditions:

- a. An engineer having a Bachelor of Science or Masters of Science Degree in Fire Protection Engineering from an accredited university engineering program, plus a minimum of 2 years' work experience in fire protection engineering.

- b. A registered professional engineer (P.E.) in fire protection engineering.
- c. A registered PE in a related engineering discipline and member grade status in the National Society of Fire Protection Engineers.
- d. An engineer with a minimum of 10 years' experience in fire protection engineering and member grade status in the National Society of Fire Protection Engineers.

1.4 SYSTEM DESIGN

1.4.1 Operation

The fire alarm and detection system shall be a complete, supervised fire alarm reporting system. The system shall be activated into the alarm mode by actuation of any alarm initiating device. The system shall remain in the alarm mode until the initiating device is reset and the fire alarm control panel is reset and restored to normal. Alarm initiating devices shall be connected to signal line circuits (SLC), Style 5 or 6, in accordance with NFPA 72. Alarm notification appliances shall be connected to notification appliance circuits (NAC), Style Z in accordance with NFPA 72. A looped conduit system shall be provided so that if the conduit and all conductors within are severed at any point, all IDC, NAC and SLC will remain functional. The conduit loop requirement is not applicable to the signal transmission link from the local panels (at the protected premises) to the Supervising Station (fire station, fire alarm central communication center). Textual, audible, and visual appliances and systems shall comply with NFPA 72. Fire alarm system components requiring power, except for the control panel power supply, shall operate on 24 Volts dc. Addressable system shall be microcomputer (microprocessor or microcontroller) based with a minimum word size of eight bits and shall provide the following features:

- a. Sufficient memory to perform as specified and as shown for addressable system.
- b. Individual identity of each addressable device for the following conditions: alarm; trouble; open; short; and appliances missing/failed remote detector - sensitivity adjustment from the panel for smoke detectors
- c. Capability of each addressable device being individually disabled or enabled from the panel.
- d. Each SLC shall be sized to provide 40 percent addressable expansion without hardware modifications to the panel.

1.4.2 Operational Features

The system shall have the following operating features:

- a. Monitor electrical supervision of SLC, and NAC.
- b. Monitor electrical supervision of the primary power (ac) supply, battery voltage, placement of alarm zone module (card, PC board) within the control panel, and transmitter tripping circuit integrity.

- c. A trouble buzzer and trouble LED/LCD (light emitting diode/liquid crystal diode) to activate upon a single break, open, or ground fault condition which prevents the required normal operation of the system. The trouble signal shall also operate upon loss of primary power (ac) supply, low battery voltage, removal of alarm zone module (card, PC board), and disconnection of the circuit used for transmitting alarm signals off-premises. A trouble alarm silence switch shall be provided which will silence the trouble buzzer, but will not extinguish the trouble indicator LED/LCD. Subsequent trouble and supervisory alarms shall sound the trouble signal until silenced. After the system returns to normal operating conditions, the trouble buzzer shall again sound until the silencing switch returns to normal position, unless automatic trouble reset is provided.
- d. A one person test mode. Activating an initiating device in this mode will activate an alarm for a short period of time, then automatically reset the alarm, without activating the transmitter during the entire process.
- e. A transmitter disconnect switch to allow testing and maintenance of the system without activating the transmitter but providing a trouble signal when disconnected and a restoration signal when reconnected.
- f. Evacuation alarm silencing switch which, when activated, will silence alarm devices, but will not affect the zone indicating LED/LCD nor the operation of the transmitter. This switch shall be over-ridden upon activation of a subsequent alarm from an unalarmed device and the NAC devices will be activated.
- g. Electrical supervision for circuits used for supervisory signal services (i.e., sprinkler systems, valves, etc.). Supervision shall detect any open, short, or ground.
- h. Confirmation or verification of all smoke detectors. The control panel shall interrupt the transmission of an alarm signal to the system control panel for a factory preset period. This interruption period shall be adjustable from 1 to 60 seconds and be factory set at 20 seconds. Immediately following the interruption period, a confirmation period shall be in effect during which time an alarm signal, if present, will be sent immediately to the control panel. Fire alarm devices other than smoke detectors shall be programmed without confirmation or verification.
- i. The fire alarm control panel shall provide supervised addressable relays for HVAC shutdown. An override at the HVAC panel shall not be provided.
- j. The fire alarm control panel shall provide the required monitoring and supervised control outputs needed to accomplish elevator recall.
- k. The fire alarm control panel shall monitor the fire sprinkler system, or other fire protection extinguishing system.
- l. The control panel and field panels shall be software reprogrammable, by the base operations and maintenance staff, to enable expansion or modification of the system without replacement of hardware or firmware. Examples of required changes are: adding or deleting devices or zones; changing system responses to particular input signals; programming certain input signals to activate auxiliary devices.

- m. Zones for SLC and NAC shall be arranged as indicated on the contract drawings.
- n. The fire alarm control panel shall provide power for single station smoke detectors.

1.4.3 Alarm Functions

An alarm condition on a circuit shall automatically initiate the following functions:

- a. Transmission of signals over the station radio fire reporting system.
- b. Visual indications of the alarmed devices on the fire alarm control panel display.
- c. Continuous sounding or operation of alarm notification appliances throughout the building as required by ANSI S3.41.
- d. Closure of doors held open by electromagnetic devices.
- e. Operation of the smoke control system.
- f. Deactivation of the air handling units throughout the building.
- g. Shutdown of power to the data processing equipment in the alarmed area.
- h. Continuous sounding of single station smoke detectors by reverse power polarity.

1.4.4 Primary Power

Operating power shall be provided as required by paragraph Power Supply for the System. Transfer from normal to emergency power or restoration from emergency to normal power shall be fully automatic and not cause transmission of a false alarm. Loss of ac power shall not prevent transmission of a signal via the fire reporting system upon operation of any initiating circuit.

1.4.5 Battery Backup Power

Battery backup power shall be through use of rechargeable, sealed-type storage batteries and battery charger.

1.4.6 Interface With Existing Fire Alarm Equipment

The equipment specified herein shall operate as an extension to an existing configuration. The new equipment shall be connected to existing monitoring equipment at the Supervising Station (Building 2016). Existing monitoring equipment shall be expanded, modified, or supplemented as necessary to extend the existing monitoring functions to the new points or zones. New components shall be capable of merging with the existing configuration without degrading the performance of either system. The scope of the acceptance tests of paragraph Testing shall include aspects of operation that involve combined use of both new and existing portions of the final configuration.

1.5 TECHNICAL DATA AND COMPUTER SOFTWARE

Technical data and computer software (meaning technical data which relates to computer software) which is specifically identified in this project, and which may be defined/required in other specifications, shall be delivered, strictly in accordance with the CONTRACT CLAUSES. Data delivered shall be identified by reference to the particular specification paragraph against which it is furnished. Data to be submitted shall include complete system, equipment, and software descriptions. Descriptions shall show how the equipment will operate as a system to meet the performance requirements of this contract. The data package shall also include the following:

- (1) Identification of programmable portions of system equipment and capabilities.
- (2) Description of system revision and expansion capabilities and methods of implementation detailing both equipment and software requirements.
- (3) Provision of operational software data on all modes of programmable portions of the fire alarm and detection system.
- (4) Description of Fire Alarm Control Panel equipment operation.
- (5) Description of auxiliary and remote equipment operations.
- (6) Library of application software.
- (7) Operation and maintenance manuals as specified in SD-10 of the Submittals paragraph.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt, dust, and any other contaminants.

PART 2 PRODUCTS

2.1 CONTROL PANEL

Control Panel shall comply with the applicable requirements of UL 864. Panel shall be modular, installed in a surface mounted steel cabinet with hinged door and cylinder lock. Control panel shall be a clean, uncluttered, and orderly assembled panel containing components and equipment required to provide the specified operating and supervisory functions of the system. The panel shall have prominent rigid plastic, phenolic or metal identification plates for LED/LCDs, zones, SLC, controls, meters, fuses, and switches. Nameplates for fuses shall also include ampere rating. The LED/LCD displays shall be located on the exterior of the cabinet door or be visible through the cabinet door. Control panel switches shall be within the locked cabinet. A suitable means (single operation) shall be provided for testing the control panel visual indicating devices (meters or LEDs/LCDs). Meters and LEDs shall be plainly visible when the cabinet door is closed. Signals and LEDs/LCDs shall be provided to indicate by zone any alarm, supervisory or trouble condition on the system. Loss of power, including batteries, shall not require the manual reloading of a program. Upon restoration of power, startup shall be automatic, and shall not require any

manual operation. The loss of primary power or the sequence of applying primary or emergency power shall not affect the transmission of alarm, supervisory or trouble signals. Visual annunciation shall be provided for LED/LCD visual display as an integral part of the control panel and shall identify with a word description and id number each device. Cabinets shall be provided with ample gutter space to allow proper clearance between the cabinet and live parts of the panel equipment. If more than one modular unit is required to form a control panel, the units shall be installed in a single cabinet large enough to accommodate units. Cabinets shall be painted red. Control panel shall be a Siemens-Cerberus, Silent Knight, Notifier, or Edwards System Technology product, or approved equal.

2.1.2 Circuit Connections

Circuit conductors entering or leaving the panel shall be connected to screw-type terminals with each conductor and terminal marked for identification.

2.1.3 System Expansion and Modification Capabilities

Any equipment and software needed by qualified technicians to implement future changes to the fire alarm system shall be provided as part of this contract.

2.1.4 Addressable Control Module

The control module shall be capable of operating as a relay (dry contact form C) for interfacing the control panel with other systems, and to control door holders or initiate elevator fire service. The module shall be UL listed as compatible with the control panel. The indicating device or the external load being controlled shall be configured as a Style Y notification appliance circuits. The system shall be capable of supervising, audible, visual and dry contact circuits. The control module shall have both an input and output address. The supervision shall detect a short on the supervised circuit and shall prevent power from being applied to the circuit. The control model shall provide address setting means compatible with the control panel's SLC supervision and store an internal identifying code. The control module shall contain an integral LED that flashes each time the control module is polled.

2.2 STORAGE BATTERIES

Storage batteries shall be provided and shall be 24 Vdc sealed, lead-calcium type requiring no additional water. The batteries shall have ample capacity, with primary power disconnected, to operate the fire alarm system for a period of 72 hours. Following this period of battery operation, the batteries shall have ample capacity to operate all components of the system, including all alarm signaling devices in the total alarm mode for a minimum period of 15 minutes. Batteries shall be located in a separate battery cabinet. Batteries shall be provided with overcurrent protection in accordance with NFPA 72. Separate battery cabinets shall have a lockable, hinged cover similar to the fire alarm panel. The lock shall be keyed the same as the fire alarm control panel. Cabinets shall be painted to match the fire alarm control panel.

2.3 BATTERY CHARGER

Battery charger shall be completely automatic, 24 Vdc with high/low charging rate, capable of restoring the batteries from full discharge (18 Volts dc) to full charge within 48 hours. A pilot

light indicating when batteries are manually placed on a high rate of charge shall be provided as part of the unit assembly, if a high rate switch is provided. Charger shall be located in control panel cabinet or in a separate battery cabinet.

2.4 ADDRESSABLE MANUAL FIRE ALARM STATIONS

Addressable manual fire alarm stations shall conform to the applicable requirements of UL 38. Manual stations shall be connected into signal line circuits. Stations shall be installed on semi-flush mounted outlet boxes. Manual stations shall be mounted at 1370 mm. (54 inches.) Stations shall be double action type. Stations shall be finished in red, with raised letter operating instructions of contrasting color. Stations requiring the breaking of glass or plastic panels for operation are not acceptable. Stations employing glass rods are not acceptable. The use of a key or wrench shall be required to reset the station. Gravity or mercury switches are not acceptable. Switches and contacts shall be rated for the voltage and current upon which they operate. Addressable pull stations shall be capable of being field programmed, shall latch upon operation and remain latched until manually reset. Stations shall have a separate screw terminal for each conductor. Surface mounted boxes shall be matched and painted the same color as the fire alarm manual stations.

2.5 FIRE DETECTING DEVICES

Fire detecting devices shall comply with the applicable requirements of NFPA 72, NFPA 90A, UL 268, UL 268A, and UL 521. The detectors shall be provided as indicated. Detector base shall have screw terminals for making connections. No solder connections will be allowed. Detectors located in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD. Addressable fire detecting devices, except flame detectors, shall be dynamically supervised and uniquely identified in the control panel. All fire alarm initiating devices shall be individually addressable, except where indicated. All initiating devices shall be mounted on back-boxes. Surface mount back-boxes shall be the fire alarm system manufacturer's catalog product matched in size, color, and shape to fully support the devices mounted on them. Standard electrical device boxes (sheet metal boxes with knock-outs) shall not be acceptable for surface mount application. Dimensions of back-boxes for surface mount application shall match the dimensions of the initiating devices or notification appliances mounted on them; over-hang shall not be acceptable.

2.5.1 Heat Detectors

Heat detectors shall be designed for detection of fire by fixed temperature. Heat detector spacing shall be rated in accordance with UL 521. Detectors located in areas subject to moisture, exterior atmospheric conditions, or hazardous locations as defined by NFPA 70, shall be types approved for such locations. Heat detectors located in attic spaces or similar concealed spaces below the roof shall be intermediate temperature rated.

2.5.1.1 Combination Fixed-Temperature and Rate-of-Rise Detectors

Detectors shall be designed for semi-flush outlet box mounting and supported independently of wiring connections. Contacts shall be self-resetting after response to rate-of-rise principle. Under fixed temperature actuation, the detector shall have a permanent external indication which is readily visible. Detector units located in boiler rooms, showers, or other areas subject to abnormal temperature changes shall operate on fixed temperature principle only.

The UL 521 test rating for the fixed temperature portion shall be 57.2 degrees C. (135degrees F.) The UL 521 test rating for the Rate-of-Rise detectors shall be rated for 15 by 15 m. (50 by 50 ft.)

2.5.1.3 Fixed Temperature Detectors

Detectors shall be designed for surface outlet box mounting and supported independently of wiring connections. Detectors shall be designed to detect high heat. The detectors shall have a specific temperature setting of 90 degrees C. (195 degrees F.). The UL 521 test rating for the fixed temperature detectors shall be rated for 4.57 by 4.57 m. (15 by 15 ft.)

2.5.2 Smoke Detectors

Smoke detectors shall be designed for detection of abnormal smoke densities. Smoke detectors shall be photoelectric type. Detectors shall contain a visible indicator LED/LCD that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Detectors shall be the plug-in type in which the detector base contains terminals for making wiring connections. Detectors that are to be installed in concealed (above false ceilings, etc.) locations shall be provided with a remote indicator LED/LCD suitable for mounting in a finished, visible location.

2.5.2.2 Photoelectric Detectors

Detectors shall operate on a light scattering concept using an LED light source. Failure of the LED shall not cause an alarm condition. Detectors shall be factory set for sensitivity and shall require no field adjustments of any kind. Detectors shall have an obscuration rating in accordance with UL 268. Addressable smoke detectors shall be capable of having the sensitivity being remotely adjusted by the control panel.

2.5.2.4 Duct Detectors

Duct-mounted photoelectric smoke detectors shall be furnished and installed where indicated and in accordance with NFPA 90A. Units shall consist of a smoke detector as specified in paragraph Photoelectric Detectors, mounted in a special housing fitted with duct sampling tubes. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have a manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. (500 and 4000 fpm.) Detectors shall be powered from the fire alarm panel. Sampling tubes shall run the full width of the duct. The duct detector package shall conform to the requirements of NFPA 90A, UL 268A, and shall be UL listed for use in air-handling systems. The control functions, operation, reset, and bypass shall be controlled from the fire alarm control panel. Lights to indicate the operation and alarm condition; and the test and reset buttons shall be visible and accessible with the unit installed and the cover in place. Detectors mounted above 1.83 m (6 feet) and those mounted below 1.83 m (6 feet) that cannot be easily accessed while standing on the floor, shall be provided with a remote detector indicator panel containing test and reset switches. Remote lamps and switches as well as the affected fan units shall be properly identified in etched plastic placards. Detectors shall have auxiliary contacts to provide control, interlock, and shutdown functions specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM. The detectors shall be supplied by the fire alarm system manufacturer to ensure complete system compatibility.

2.5.3 Single Station Smoke Detectors

Single station smoke detectors shall have an audible device (self-contained) and be designed for detection of abnormal smoke densities by the photoelectric principle. Smoke detectors shall be provided with an LED light source. Failure of the LED shall not cause an alarm condition and the sensitivity shall be factory set at a nominal 3 percent and require no field adjustments of any kind. The audible appliances shall have a minimum sound output of at least 85 dBA at 3.05 m. (10 feet.) Detectors shall contain a visible indicator LED that shows when the unit is in alarm condition. Detectors shall not be adversely affected by vibration or pressure. Single station smoke detectors audible devices shall have reverse polarity audible capability.

2.6 NOTIFICATION APPLIANCES

Audible appliances shall conform to the applicable requirements of UL 464. Devices shall be connected into notification appliance circuits. Devices shall have a separate screw terminal for each conductor. Audible appliances shall generate a unique audible sound from other devices provided in the building and surrounding area. Surface mounted audible appliances shall be painted white. Recessed audible appliances shall be installed with a grill that is painted white. All notification appliances shall be mounted on back-boxes. Surface mount back-boxes shall be the fire alarm system manufacturer's catalog product matched in size, color, and shape to fully support the devices mounted on them. Standard electrical device boxes (sheet metal boxes with knock-outs) shall not be acceptable for surface mount application. Dimensions of back-boxes for surface mount application shall match the dimensions of the notification appliances mounted on them; over-hang shall not be acceptable.

2.6.2 Alarm Horns

Horns shall be surface mounted, with the matching mounting back box recessed and suitable for use in an electrically supervised circuit. Horns shall produce a sound rating of at least 95 dBA at 3.05 m. (10 feet.) Horns used in exterior locations shall be specifically listed or approved for outdoor use and be provided with metal housing and protective grilles.

2.6.4 Visual Notification Appliances

Visual notification appliances shall conform to the applicable requirements of UL 1971 and the contract drawings. Appliances shall have clear high intensity optic lens, xenon flash tubes, and output white light. Strobe flash rate shall be between 1 to 2 flashes per second and a minimum of 75 candela. Strobe shall be surface or semi-flush mounted.

2.6.5 Combination Audible/Visual Notification Appliances

Combination audible/visual notification appliances shall provide the same requirements as individual units except they shall mount as a unit in standard backboxes. Units shall be factory assembled. Any other audible notification appliance employed in the fire alarm systems shall be approved by the Contracting Officer.

2.7 FIRE DETECTION AND ALARM SYSTEM PERIPHERAL EQUIPMENT

2.7.1 Electromagnetic Door Hold-Open Devices

Devices shall be attached to the walls unless otherwise indicated. Devices shall comply with the appropriate requirements of UL 228. Devices shall operate on 24 Volt dc power. Compatible magnetic component shall be attached to the door. Under normal conditions, the magnets shall attract and hold the doors open. When magnets are de-energized, they shall release the doors. Magnets shall have a holding force of 111.2 N (25 pounds). Devices shall be UL or FM approved. Housing for devices shall be brushed aluminum or stainless steel. Operation shall be fail safe with no moving parts. Electromagnetic door hold-open devices shall not be required to be held open during building power failure.

2.7.2 Conduit

Conduit and fittings shall comply with NFPA 70, UL 6, UL 1242, and UL 797.

2.7.3 Wiring

Wiring shall conform to NFPA 70. Wiring for 120 Vac power shall be No. 12 AWG minimum. The SLC wiring shall be copper cable in accordance with the manufacturers requirements. Wiring for fire alarm dc circuits shall be No. 14 AWG minimum. Voltages shall not be mixed in any junction box, housing, or device, except those containing power supplies and control relays. Wiring shall conform to NFPA 70. System field wiring shall be solid copper and installed in metallic conduit or electrical metallic tubing, except that rigid plastic conduit may be used under slab-on-grade. Conductors shall be color coded. Conductors used for the same functions shall be similarly color coded. Wiring code color shall remain uniform throughout the circuit. Pigtail or T-tap connections to initiating device circuits, supervisory alarm circuits, and notification appliance circuits are prohibited. T-tapping using screw terminal blocks is allowed for style 5 addressable systems.

2.7.4 Special Tools and Spare Parts

Manuals for fire alarm system and documentation showing mapping /tree of devices (showing the polling sequence), and all software/hardware required for programming/editing, as well as connecting cables and proprietary equipment, necessary for the maintenance, testing, and reprogramming of the equipment shall be furnished to Public Works through the Contracting Officer. Two spare fuses of each type and size required shall be furnished. Two percent of the total number of each different type of device (e.g. bases, sounder bases, modules, detectors, pull stations, horn strobes, magnetic door holders, etc.) used in the system, but no less than two each, shall be furnished to Public Works through the Contracting Officer at time of acceptance testing. Spare fuses shall be mounted in the fire alarm panel.

2.8 TRANSMITTERS

2.8.1 Radio Alarm Transmitters

Transmitters shall be compatible with proprietary supervising station receiving equipment. Each radio alarm transmitter shall be the manufacturer's recognized commercial product, completely assembled, wired, factory tested, and delivered ready for installation and operation. Transmitters shall be provided in accordance with applicable portions of NFPA 72,

NFPA 1221, and 47 CFR 15. Transmitter electronics module shall be contained within the physical housing as an integral, removable assembly. The proprietary supervising station receiving equipment is King-Fisher (2350 Foster Avenue, Wheeling, Illinois 60090, 847-398-7100, www.kfco.com) and the transceiver shall be fully compatible with this equipment. At the contractor's option, and if UL listed, the transmitter may be housed in the same panel as the fire alarm control panel.

2.8.1.1 Transmitter Power Supply

Each radio alarm transmitter shall be powered by a combination of locally available 120-volt ac power and a sealed, lead-calcium battery.

a. Operation: Each transmitter shall operate from 120-volt ac power. In the event of 120-volt ac power loss, the transmitter shall automatically switch to battery operation. Switchover shall be accomplished with no interruption of protective service, and shall automatically transmit a trouble message. Upon restoration of ac power, transfer back to normal ac power supply shall also be automatic.

b. Battery Power: Transmitter standby battery capacity shall provide sufficient power to operate the transmitter in a normal standby status for a minimum of 72 hours and be capable of transmitting alarms during that period.

2.8.1.2 Radio Alarm Transmitter Housing

Transmitter housing shall be NEMA Type 1. The housing shall contain a lock that is keyed identical to radio alarm transmitter housings on the base. Radio alarm transmitter housing shall be factory painted with a suitable priming coat and not less than two coats of a hard, durable weatherproof enamel.

2.8.1.3 Antenna

The Contractor shall provide omnidirectional, coaxial, halfwave dipole antennas for radio alarm transmitters with a driving point impedance to match transmitter output. The antenna and antenna mounts shall be corrosion resistant and designed to withstand wind velocities of 161 km/h. (100 mph.) Antennas shall not be mounted to any portion of the building roofing system.

PART 3 EXECUTION

3.1 INSTALLATION

All work shall be installed as shown and in accordance with the manufacturer's diagrams and recommendations, unless otherwise specified. Smoke detectors shall not be installed until construction is essentially complete and the building has been thoroughly cleaned.

3.1.1 Power Supply for the System

A single dedicated circuit connection for supplying power from a branch circuit to each building fire alarm system shall be provided. The power shall be supplied as shown on the drawings. The power supply shall be equipped with a locking mechanism and marked in red with the words "FIRE ALARM CIRCUIT CONTROL".

3.1.2 Wiring

Conduit size for wiring shall be in accordance with NFPA 70. Wiring for the fire alarm system shall not be installed in conduits, junction boxes, or outlet boxes with conductors of lighting and power systems. Not more than two conductors shall be installed under any device screw terminal. The wires under the screw terminal shall be straight when placed under the terminal then clamped in place under the screw terminal. The wires shall be broken and not twisted around the terminal. Circuit conductors entering or leaving any mounting box, outlet box enclosure, or cabinet shall be connected to screw terminals with each terminal and conductor marked in accordance with the wiring diagram. Connections and splices shall be made using screw terminal blocks. The use of wire nut type connectors in the system is prohibited. Wiring within any control equipment shall be readily accessible without removing any component parts. The fire alarm equipment manufacturer's representative shall be present for the connection of wiring to the control panel.

3.1.3 Control Panel

The control panel and its assorted components shall be mounted so that no part of the enclosing cabinet is less than 300 mm (12 inches) nor more than 2000 mm (78 inches) above the finished floor. Manually operable controls shall be between 900 and 1100 mm (36 and 42 inches) above the finished floor. Panel shall be installed to comply with the requirements of UL 864.

3.1.4 Detectors

Detectors shall be located and installed in accordance with NFPA 72. Detectors shall be connected into signal line circuits or initiating device circuits as indicated on the drawings. Detectors shall be at least 300 mm (12 inches) from any part of any lighting fixture. Detectors shall be located at least 900 mm (3 feet) from diffusers of air handling systems. Each detector shall be provided with appropriate mounting hardware as required by its mounting location. Detectors which mount in open space shall be mounted directly to the end of the stubbed down rigid conduit drop. Conduit drops shall be firmly secured to minimize detector sway. Where length of conduit drop from ceiling or wall surface exceeds 900 mm (3 feet) sway bracing shall be provided. Detectors installed in concealed locations (above ceiling, raised floors, etc.) shall have a remote visible indicator LED/LCD in a finished, visible location.

3.1.5 Notification Appliances

Notification appliances shall be mounted 2.3M (90 inches) above the finished floor or 150 mm (6 inches) below the ceiling, whichever is lower.

3.1.6 Addressable Control Module

Addressable and control modules shall be installed in the outlet box or adjacent to the device they are controlling. If a supplementary suppression releasing panel is provided, then the monitor modules shall be mounted in a common enclosure adjacent to the suppression releasing panel and both this enclosure and the suppression releasing panel shall be in the same room as the releasing devices. All interconnecting wires shall be supervised unless an open circuit or short circuit abnormal condition does not affect the required operation of the

fire alarm system. If control modules are used as interfaces to other systems, such as HVAC or elevator control, they shall be within the control panel or immediately adjacent to it. Control modules that control a group of notification appliances shall be adjacent to the first notification appliance in the notification appliance circuits. Control modules that connect to devices shall supervise the notification appliance circuits. Control modules that connect to auxiliary systems or interface with other systems (non-life safety systems) and where not required by NFPA 72, shall not require the secondary circuits to be supervised. Contacts in suppression systems and other fire protection subsystems shall be connected to the fire alarm system to perform required alarm functions as specified in Section 13930 WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

3.2 OVERVOLTAGE AND SURGE PROTECTION

3.2.1 Power Line Surge Protection

All equipment connected to alternating current circuits shall be protected from surges per IEEE C62.41 B3 combination waveform and NFPA 70. Fuses shall not be used for surge protection. The surge protector shall be rated for a maximum let through voltage of 350 Volts ac (line-to-neutral) and 350 Volts ac (neutral-to-ground).

3.3 GROUNDING

Grounding shall be provided by connecting to building ground system.

3.4 SUPERVISING STATION PROVISIONS

The proprietary type Supervising Station (PSS) is located in building 2016. The supervising equipment is existing and consists of the following brands and models: King-Fisher emergency alarm receiver.

3.4.1 Revisions to Existing Facilities

Existing supervising components shall be modified and programming shall be updated if required to accommodate the revised configuration. Acceptance testing shall include procedures that would demonstrate that operation of existing equipment has not been degraded and that the revised configuration plus interfacing components operates compatibly with the new fire alarm system at the protected premises. Work on existing equipment shall be performed in accordance with the manufacturer's instructions or under supervision of the manufacturer's representative.

3.5 TESTING

The Contractor shall notify the Contracting Officer at least 10 days before the preliminary and acceptance tests are to be conducted. The tests shall be performed in accordance with the approved test procedures in the presence of the Contracting Officer. The control panel manufacturer's representative shall be present to supervise tests. The Contractor shall furnish instruments and personnel required for the tests.

3.5.1 Preliminary Tests

Upon completion of the installation, the system shall be subjected to functional and operational performance tests including tests of each installed initiating and notification appliance, when required. Tests shall include the meggering of system conductors to determine that the system is free from grounded, shorted, or open circuits. The megger test shall be conducted prior to the installation of fire alarm equipment. If deficiencies are found, corrections shall be made and the system shall be retested to assure that it is functional. After completing the preliminary testing the Contractor shall complete and submit the NFPA 72, Certificate of Completion.

3.5.2 Acceptance Test

Acceptance testing shall not be performed until the Contractor has completed and submitted the Certificate of Completion. Testing shall be in accordance with NFPA 72. The recommended tests in NFPA 72 shall be considered mandatory and shall verify that previous deficiencies have been corrected. The Contractor shall complete and submit the NFPA 72, Inspection and Testing Form. The test shall include all requirements of NFPA 72 and the following:

- a. Test of each function of the control panel.
- b. Test of each circuit in both trouble and normal modes.
- c. Tests of each alarm initiating devices in both normal and trouble conditions.
- d. Tests of each control circuit and device.
- e. Tests of each alarm notification appliance.
- f. Tests of the battery charger and batteries.
- g. Complete operational tests under emergency power supply.
- h. Visual inspection of wiring connections.
- i. Opening the circuit at each alarm initiating device and notification appliance to test the wiring supervisory feature.
- j. Ground fault
- k. Short circuit faults
- l. Stray voltage
- m. Loop resistance

3.6 TRAINING

Training course shall be provided for the operations and maintenance staff. The course shall be conducted in the building where the system is installed or as designated by the

Contracting Officer. The training period shall consist of a minimum of 1 training day (8 hours per day) and shall start after the system is functionally completed but prior to final acceptance tests. The instructions shall cover items contained in the operating and maintenance instructions. In addition, training shall be provided on performance of expansions or modifications to the fire detection and alarm system.

END OF SECTION

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SECTION 13930

WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	(1999; R 1995) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 135	(1997c) Electric-Resistance-Welded Steel Pipe
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 536	(R 1999e1) Ductile Iron Castings
ASTM A 795	(1997) Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)

ASME INTERNATIONAL (ASME)

ASME B16.1	(1998) Cast Iron Pipe Flanges and Flanged Fittings
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Cast Iron Threaded Fittings
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges

ASME B16.22 (1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

ASME B18.2.1 (1996) Square and Hex Bolts and Screws (Inch Series)

ASME B18.2.2 (1987; R 1993) Square and Hex Nuts (Inch Series)

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND
SANITARY RESEARCH (ASSE)

ASSE 1015 (1993) Double Check Backflow Prevention Assembly

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW (1999) Standard Methods for the Examination of Water and Wastewater

AWWA B300 (1999) Hypochlorites

AWWA B301 (1992; addenda B301a - 1999) Liquid Chlorine
AWWA C104 (1995) Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water

AWWA C110 (1998) Ductile-Iron and Gray-Iron Fittings, 3 In. Through 48 In. (75 mm through 1200 mm), for Water and Other Liquids

AWWA C111 (1995) Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

AWWA C151 (1996) Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids

AWWA C203 (1997) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a (1998) Approval Guide Fire Protection

FM P7825b (1998) Approval Guide Electrical Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND
FITTINGS INDUSTRY (MSS)

MSS SP-71 (1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 13	(1999) Installation of Sprinkler Systems
NFPA 13R	(1999) Installation of Sprinkler Systems in Residential Occupancies Up to and Including Four Stories in Height
NFPA 24	(1995) Installation of Private Fire Service Mains and Their Appurtenances
NFPA 230	(1999) Fire Protection of Storage
NFPA 1963	(1998) Fire Hose Connections

NATIONAL INSTITUTE FOR CERTIFICATION IN ENGINEERING TECHNOLOGIES (NICET)

NICET 1014-7	(1995) Program Detail Manual for Certification in the Field of Fire Protection Engineering Technology (Field Code 003) Subfield of Automatic Sprinkler System Layout
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UNDERWRITERS LABORATORIES (UL)

UL 668	(1995; Rev through Dec 1998) Hose Valves For Fire Protection Service
UL Bldg. Mat Dir.	(1999) Building Materials Directory
UL Fire Prot. Dir.	(1999) Fire Protection Equipment Directory

1.2 GENERAL REQUIREMENTS

Wet pipe sprinkler system shall be provided in areas indicated on the drawings. The sprinkler system shall provide fire sprinkler protection for the entire area. Except as modified herein, the system shall be designed and installed in accordance with NFPA 13 and as specified herein. Pipe sizes which are not indicated on drawings shall be determined by hydraulic calculation. The Contractor shall design any portions of the sprinkler system that are not indicated on the drawings including locating sprinklers, piping and equipment, and size piping and equipment when this information is not indicated on the drawings or is not specified herein. The design of the sprinkler system shall be based on hydraulic calculations, and the other provisions specified herein. All designs shall have approval by Jurisdictional authority (Fort Lewis Fire Department).

1.2.1 Hydraulic Design

The system shall be hydraulically designed to discharge a minimum density of 0.10 gpm per square foot over the hydraulically most demanding 3,000 square feet of floor area. The minimum pipe size for branch lines in gridded systems shall be 32 mm (1-1/4 inch). Hydraulic calculations shall be in accordance with the Area/Density Method of NFPA 13. Water velocity in the piping shall not exceed (6 m/s) 20 ft/s.

1.2.1.1 Hose Demand

An allowance for exterior hose streams of 250 gpm shall be added to the sprinkler system demand at the fire hydrant shown on the drawings closest to the point where the water service enters the building.

1.2.1.2 Basis for Calculations

The design of the system shall be based upon a water supply with a static pressure of 67 psi, and a flow of 550 gpm at a residual pressure of 50 psi. Water supply shall be presumed available at the point of connection to existing. Hydraulic calculations shall be based upon the Hazen-Williams formula with a "C" value of 120 for steel piping, 150 for copper tubing, 140 for new cement-lined ductile-iron piping, and 100 for existing underground piping.

1.2.2 Sprinkler Spacing

Sprinklers shall be uniformly spaced on branch lines. Maximum spacing per sprinkler shall not exceed limits specified in NFPA 13 for light hazard occupancy.

1.3 COORDINATION OF TRADES

Piping offsets, fittings, and any other accessories required shall be furnished as required to provide a complete installation and to eliminate interference with other construction. Sprinkler shall be installed over and under ducts, piping and platforms when such equipment can negatively effect or disrupt the sprinkler discharge pattern and coverage.

1.4 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be housed in a manner to preclude any damage from the weather, humidity and temperature variations, dirt and dust, or other contaminants. Additionally, all pipes shall either be capped or plugged until installed.

1.5 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.6 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES::

SD-02 Shop Drawings

Sprinkler System Shop Drawings; G,.

Three copies of the Sprinkler System Shop Drawings, no later than 21 days prior to the start of sprinkler system installation. The Sprinkler System Shop Drawings

shall conform to the requirements established for working plans as prescribed in NFPA 13. Drawings shall include plan and elevation views demonstrating that the equipment will fit the allotted spaces with clearance for installation and maintenance. Each set of drawings shall include the following:

- a. Descriptive index of drawings in the submittal with drawings listed in sequence by drawing number. A legend identifying device symbols, nomenclature, and conventions used.
- b. Floor plans drawn to a scale not less than 1:100 ($1/8" = 1'-0"$) which clearly show locations of sprinklers, risers, pipe hangers, seismic separation assemblies, sway bracing, inspector's test connections, drains, and other applicable details necessary to clearly describe the proposed arrangement. Each type of fitting used and the locations of bushings, reducing couplings, and welded joints shall be indicated.
- c. Actual center-to-center dimensions between sprinklers on branch lines and between branch lines; from end sprinklers to adjacent walls; from walls to branch lines; from sprinkler feed mains, cross-mains and branch lines to finished floor and roof or ceiling. A detail shall show the dimension from the sprinkler and sprinkler deflector to the ceiling in finished areas.
- d. Longitudinal and transverse building sections showing typical branch line and cross-main pipe routing as well as elevation of each typical sprinkler above finished floor.
- e. Details of each type of riser assembly; pipe hanger; sway bracing for earthquake protection, and restraint of underground water main at point-of-entry into the building, and electrical devices and interconnecting wiring.

As-Built Shop Drawings;.

As-built shop drawings, at least 14 days after completion of the Final Tests. The Sprinkler System Drawings shall be updated to reflect as-built conditions after all related work is completed and shall be on reproducible full-size mylar film.

SD-03 Product Data

Fire Protection Related Submittals;.

A list of the Fire Protection Related Submittals, no later than 7 days after the approval of the Fire Protection Specialist.

Load Calculations for Sizing Sway Bracing; G,.

For systems that are required to be protected against damage from earthquakes, load calculations shall be provided for sizing of sway bracing.

Components and Equipment Data; G,.

Manufacturer's catalog data included with the Sprinkler System Drawings for all items specified herein. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with all contract requirements. In addition, a complete equipment list that includes equipment description, model number and quantity shall be provided.

Hydraulic Calculations; G,.

Hydraulic calculations, including a drawing showing hydraulic reference points and pipe segments.

Spare Parts.

Spare parts data shall be included for each different item of material and equipment specified. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended by the manufacturer to be replaced after 1 year and 3 years of service. A list of special tools and test equipment required for maintenance and testing of the products supplied by the Contractor shall be included.

Preliminary Tests Procedures; G,.

Proposed procedures for Preliminary Tests, no later than 14 days prior to the proposed start of the tests.

Final Acceptance Test Procedures; G,.

Proposed procedures for Final Acceptance Test, no later than 14 days prior to the proposed start of the tests.

On-site Training Schedule; G,.

Proposed On-site Training schedule, at least 14 days prior to the start of related training.

Preliminary Tests; G,.

Proposed date and time to begin Preliminary Tests, submitted with the Preliminary Tests Procedures.

Final Acceptance Test; G,.

Proposed date and time to begin Final Acceptance Test, submitted with the Final Acceptance Test Procedures. Notification shall be provided at least 14 days prior to the proposed start of the test.

Fire Protection Specialist Qualifications; G;.

The name and documentation of certification of the proposed Fire Protection Specialists, no later than 14 days after the Notice to Proceed and prior to the submittal of the sprinkler system drawings and hydraulic calculations.

Sprinkler System Installer Qualifications; G;.

The name and documentation of certification of the proposed Sprinkler System Installer, concurrent with submittal of the Fire Protection Specialist Qualifications.

SD-06 Test Reports

Preliminary Tests Report; G;.

Three copies of the completed Preliminary Tests Reports, no later than 7 days after the completion of the Preliminary Tests. The Preliminary Tests Report shall include both the Contractor's Material and Test Certificate for Underground Piping and the Contractor's Material and Test Certificate for Aboveground Piping. All items in the Preliminary Tests Report shall be signed by the Fire Protection Specialist.

Final Acceptance Test Report; G;.

Three copies of the completed Final Acceptance Tests Reports, no later than 7 days after the completion of the Final Acceptance Tests. All items in the Final Acceptance Report shall be signed by the Fire Protection Specialist.

SD-07 Certificates

Fire Protection Specialist Inspection; G;.

Concurrent with the Final Acceptance Test Report, certification by the Fire Protection Specialist that the sprinkler system is installed in accordance with the contract requirements, including signed approval of the Preliminary and Final Acceptance Test Reports.

SD-10 Operation and Maintenance Data

Wet Pipe Sprinkler System; G;.

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 14 days prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 4 hour on-site response to a service call on an emergency basis.

1.7 HYDRAULIC CALCULATIONS

Hydraulic calculations shall be as outlined in NFPA 13 except that calculations shall be performed by computer using software intended specifically for fire protection system design using the design data shown on the drawings. Software that uses k-factors for typical branch lines is not acceptable. Calculations shall be based on the water supply data specified herein and with point of connection as shown on the drawings. Calculations shall substantiate that the design area used in the calculations is the most demanding hydraulically. Water supply curves and system requirements shall be plotted on semi-logarithmic graph paper so as to present a summary of the complete hydraulic calculation. A summary sheet listing sprinklers in the design area and their respective hydraulic reference points, elevations, actual discharge pressures and actual flows shall be provided. Elevations of hydraulic reference points (nodes) shall be indicated. Documentation shall identify each pipe individually and the nodes connected thereto. The diameter, length, flow, velocity, friction loss, number and type fittings, total friction loss in the pipe, equivalent pipe length and Hazen-Williams coefficient shall be indicated for each pipe. For gridded systems, calculations shall show peaking of demand area friction loss to verify that the hydraulically most demanding area is being used. Also for gridded systems, a flow diagram indicating the quantity and direction of flows shall be included. A drawing showing hydraulic reference points (nodes) and pipe designations used in the calculations shall be included and shall be independent of shop drawings.

1.8 FIRE PROTECTION SPECIALIST

Work specified in this section shall be performed under the supervision of and certified by the Fire Protection Specialist. The Fire Protection Specialist shall be an individual who is a registered professional engineer and a Full Member of the Society of Fire Protection Engineers or who is certified as a Level III Technician by National Institute for Certification in Engineering Technologies (NICET) in the Automatic Sprinkler System Layout sub-field of Fire Protection Engineering Technology in accordance with NICET 1014-7. The Fire Protection Specialist shall be regularly engaged in the design and installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.9 SPRINKLER SYSTEM INSTALLER QUALIFICATIONS

Work specified in this section shall be performed by the Sprinkler System Installer. The Sprinkler System Installer shall be regularly engaged in the installation of the type and complexity of system specified in the Contract documents, and shall have served in a similar capacity for at least three systems that have performed in the manner intended for a period of not less than 6 months.

1.10 REGULATORY REQUIREMENTS

Compliance with referenced NFPA standards is mandatory. This includes advisory provisions listed in the appendices of such standards, as though the word "shall" had been substituted for the word "should" wherever it appears. In the event of a conflict between specific provisions of this specification and applicable NFPA standards, this specification shall govern. Reference to "authority having jurisdiction" shall be interpreted to mean the Contracting Officer.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.2 NAMEPLATES

All equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.3 REQUIREMENTS FOR FIRE PROTECTION SERVICE

Materials and Equipment shall have been tested by Underwriters Laboratories, Inc. and listed in UL Fire Prot. Dir. or approved by Factory Mutual and listed in FM P7825a and FM P7825b. Where the terms "listed" or "approved" appear in this specification, such shall mean listed in UL Fire Prot Dir or FM P7825a and FM P7825b

2.4 UNDERGROUND PIPING COMPONENTS

2.4.1 Pipe

Piping from a point 150 mm (6 inches) above the floor to a point 1500 mm (5 feet) outside the building wall shall be ductile iron with a rated working pressure of 1034 kPa 150 psi conforming to AWWA C151, with cement mortar lining conforming to AWWA C104. Piping more than 1500 mm (5 feet) outside the building walls shall comply with Section 02510 WATER DISTRIBUTION SYSTEM.

2.4.2 Fittings and Gaskets

Fittings shall be ductile iron conforming to AWWA C110. Gaskets shall be suitable in design and size for the pipe with which such gaskets are to be used. Gaskets for ductile iron pipe joints shall conform to AWWA C111.

2.4.3 Gate Valve and Indicator Posts

Gate valves for underground installation shall be of the inside screw type with counter-clockwise rotation to open. Where indicating type valves are shown or required, indicating valves shall be gate valves with an approved indicator post of a length to permit the top of the post to be located 900 mm (3 feet) above finished grade. Gate valves and indicator posts shall be listed in UL Fire Prot Dir or FM P7825a and FM P7825b.

2.5 ABOVEGROUND PIPING COMPONENTS

Aboveground piping shall be steel .

2.5.1 Steel Piping Components

2.5.1.1 Steel Pipe

Except as modified herein, steel pipe shall be black as permitted by NFPA 13 and shall conform to applicable provisions of ASTM A 795, ASTM A 53/A 53M, or ASTM A 135. Pipe in which threads or grooves are cut shall be Schedule 40 or shall be listed by Underwriters' Laboratories to have a corrosion resistance ratio (CRR) of 1.0 or greater after threads or grooves are cut. Pipe shall be marked with the name of the manufacturer, kind of pipe, and ASTM designation.

2.5.1.2 Fittings for Non-Grooved Steel Pipe

Fittings shall be cast iron conforming to ASME B16.4, steel conforming to ASME B16.9 or ASME B16.11, or malleable iron conforming to ASME B16.3. Galvanized fittings shall be used for piping systems or portions of piping systems utilizing galvanized piping. Fittings into which sprinklers, drop nipples or riser nipples (sprigs) are screwed shall be threaded type. Plain-end fittings with mechanical couplings, fittings that use steel gripping devices to bite into the pipe and segmented welded fittings shall not be used.

2.5.1.3 Grooved Mechanical Joints and Fittings

Grooved joints and fittings shall not be installed in concealed locations. Joints and fittings shall be designed for not less than 1200 kPa (175 psi) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12. Gasket shall be the flush type that fills the entire cavity between the fitting and the pipe. Nuts and bolts shall be heat-treated steel conforming to ASTM A 183 and shall be cadmium plated or zinc electroplated.

2.5.1.4 Flanges

Flanges shall conform to NFPA 13 and ASME B16.1. Gaskets shall be non-asbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thick, and full face or self-centering flat ring type. Bolts shall be squarehead conforming to ASME B18.2.1 and nuts shall be hexagon type conforming to ASME B18.2.2.

2.5.2 Copper Tube Components

2.5.2.1 Copper Tube

Copper tube shall conform to ASTM B 88M ASTM B 88, Types L and M.

2.5.2.2 Copper Fittings

Cast copper alloy pressure fittings shall conform to ASME B16.18 and wrought copper and bronze pressure fittings shall conform to ASME B16.22.

2.5.3 Not Used

2.5.4 Pipe Hangers

Hangers shall be listed in UL Fire Prot Dir. or FM P7825a and FM P7825b and of the type suitable for the application, construction, and pipe type and sized to be supported.

2.5.5 Valves

2.5.5.1 Control Valve and Gate Valve

Manually operated sprinkler control valve and gate valve shall be outside stem and yoke (OS&Y) type and shall be listed in UL Bld Mat Dir. or FM P7825a and FM P7825b.

2.5.5.2 Check Valve

Check valve 50 mm (2 inches) and larger shall be listed in UL Bld Mat Dir. or FM P7825a and FM P7825b. Check valves 100 mm (4 inches) and larger shall be of the swing type with flanged cast iron body and flanged inspection plate, shall have a clear waterway and shall meet the requirements of MSS SP-71, for Type 3 or 4.

2.5.5.3 Hose Valve

Valve shall comply with UL 668 and shall have a minimum rating of 2070 kPa (300 psi). Valve shall be non-rising stem, all bronze, 90 degree angle type, with 65 mm (2-1/2 inch) American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Hose valve shall be provided with 65 to 40 mm (2-1/2 to 1-1/2) inch reducer. Hose valves shall be equipped with lugged cap with drip drain, cap gasket and chain.

2.6 Not Used

2.7 WATERFLOW ALARM

Electrically operated, exterior-mounted, waterflow alarm bell shall be provided and installed in accordance with NFPA 13. Waterflow alarm bell shall be rated 24 VDC and shall be connected to the Fire Alarm Control Panel(FACP) in accordance with Section 13851 FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

2.8 ALARM INITIATING AND SUPERVISORY DEVICES

2.8.1 Sprinkler Waterflow Indicator Switch, Vane Type

Switch shall be vane type with a pipe saddle and cast aluminum housing. The electro-mechanical device shall include a flexible, low-density polyethylene paddle conforming to the inside diameter of the fire protection pipe. The device shall sense water movements and be capable of detecting a sustained flow of 38 L/min (10 gpm) or greater. The device shall contain a retard device adjustable from 0 to 90 seconds to reduce the possibility of false alarms caused by transient flow surges. The switch shall be tamper resistant and contain two SPDT (Form C) contacts arranged to transfer upon removal of the housing cover, and shall

be equipped with a silicone rubber gasket to assure positive water seal and a dustproof cover and gasket to seal the mechanism from dirt and moisture.

2.8.2 Sprinkler Pressure (Waterflow) Alarm Switch

Pressure switch shall include a metal housing with a neoprene diaphragm, SPDT snap action switches and a 15 mm (1/2 inch) NPT male pipe thread. The switch shall have a maximum service pressure rating of 1207 kPa (175 psi). There shall be two SPDT (Form C) contacts factory adjusted to operate at 28 to 55 kPa (4 to 8 psi). The switch shall be capable of being mounted in any position in the alarm line trim piping of the alarm check valve.

2.8.3 Valve Supervisory (Tamper) Switch

All system valves shall have tamper switches. Switch shall be suitable for mounting to the type of control valve to be supervised open. The switch shall be tamper resistant and contain one set of SPDT (Form C) contacts arranged to transfer upon removal of the housing cover or closure of the valve of more than two rotations of the valve stem.

2.9 FIRE DEPARTMENT CONNECTION

Fire department connection shall be projecting type with cast brass body, matching wall escutcheon lettered "Auto Spkr" with a polished brass finish. The connection shall have two inlets with individual self-closing clappers, caps with drip drains and chains. Female inlets shall have 65 mm (2-1/2 inch) diameter American National Fire Hose Connection Screw Threads (NH) per NFPA 1963.

2.10 SPRINKLERS

Sprinklers with internal O-rings shall not be used. Sprinklers shall be used in accordance with their listed spacing limitations. Temperature classification shall be ordinary. Sprinklers in high heat areas including attic spaces or in close proximity to unit heaters shall have temperature classification in accordance with NFPA 13. Orifice of extended coverage sprinklers shall not exceed 13.5 mm (17/32 inch).

2.10.1 Concealed Sprinkler

Provide concealed sprinklers in all public and common areas, such as corridors and stairwells of the barracks and all areas of the SCB.

Concealed sprinkler shall be quick-response type and shall have a nominal 12.7 mm (1/2 inch) or 13.5 mm (17/32 inch) orifice.

2.10.2 Recessed Sprinkler

Provide recessed sprinklers in all room modules and the Company and Battalion buildings. Recessed sprinkler shall be chrome-plated quick-response type and shall have a nominal 12.7 mm (1/2 inch) or 13.5 mm (17/32 inch) orifice.

2.10.3 Flush Sprinkler

Flush sprinkler shall be chrome-plated quick-response type and shall have a nominal 12.7 mm (1/2 inch) or 13.5 mm (17/32 inch) orifice.

2.10.4 Pendent Sprinkler

Pendent sprinkler shall be of the fusible strut or glass bulb type, quick-response type with nominal 12.7 mm (1/2 inch) or 13.5 mm 17/32 inch orifice. Pendent sprinklers shall have a polished chrome finish.

2.10.5 Upright Sprinkler

Upright sprinkler shall be chrome-plated quick-response type and shall have a nominal 12.7 mm (1/2 inch) or 13.5 mm (17/32 inch) orifice.

2.10.8 Intermediate Level Rack Sprinkler

Intermediate level rack sprinkler shall be quick-response type, of the upright or pendent type with nominal 12.7 mm 1/2 inch orifice and minimum "K" factor of 5.5. The sprinkler shall be equipped with a deflector plate to shield the fusible element from water discharged above it.

2.10.9 Corrosion Resistant Sprinkler

Corrosion resistant sprinkler shall be the upright or pendent type installed in locations as indicated. Corrosion resistant coatings shall be factory-applied by the sprinkler manufacturer.

2.11 DISINFECTING MATERIALS

2.11.1 Liquid Chlorine

Liquid chlorine shall conform to AWWA B301.

2.11.2 Hypochlorites

Calcium hypochlorite and sodium hypochlorite shall conform to AWWA B300.

2.12 ACCESSORIES

2.12.1 Sprinkler Cabinet

Spare sprinklers shall be provided in accordance with NFPA 13 and shall be packed in a suitable metal or plastic cabinet. Spare sprinklers shall be representative of, and in proportion to, the number of each type and temperature rating of the sprinklers installed. At least one wrench of each type required shall be provided.

2.12.2 Pendent Sprinkler Escutcheon

Escutcheon shall be one-piece metallic type with a depth of less than 20 mm (3/4 inch) and suitable for installation on pendent sprinklers. The escutcheon shall have a factory finish that matches the pendent sprinkler heads.

2.12.3 Pipe Escutcheon

Escutcheon shall be polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or set screw.

2.12.4 Identification Sign

Valve identification sign shall be minimum 150 mm wide x 50 mm high (6 inches wide x 2 inches high) with enamel baked finish on minimum 1.214 mm (18 gauge) steel or 0.6 mm (0.024 inch) aluminum with red letters on a white background or white letters on red background. Wording of sign shall include, but not be limited to "main drain," "auxiliary drain," "inspector's test," "alarm test," "alarm line," and similar wording as required to identify operational components.

2.13 FIRE HOSE REEL ASSEMBLY

Assembly shall include nozzle, fire hose, reel, 40 mm (1-1/2 inch) valve, and bracket suitable for wall mounting. The assembly shall be semi-automatic type complete with Underwriters clip which permits controlled one-man operation whereby control valve can be opened, hose unreeled and clip released by pulling on hose. Valve shall be non-rising stem, all bronze, angle type with 40 mm (1-1/2 inch) American National Standard Fire Hose Screw Thread (NH) male outlet in accordance with NFPA 1963. Reel shall be of steel construction with red enamel finish and shall be equipped with 30 meters (100 feet) of 40 mm (1-1/2 inch) rubber lined fire hose. Nozzle shall be of the industrial combination fog-straight stream type with shutoff. Components of the assembly shall be listed in UL Fire Prot Dir.

2.14 DOUBLE-CHECK VALVE BACKFLOW PREVENTION ASSEMBLY (BPA'S)

Double-check backflow prevention assembly shall comply with ASSE 1015. The assembly shall have a bronze, cast-iron or stainless steel body with flanged ends. The assembly shall include pressure gauge test ports and OS&Y shutoff valves on the inlet and outlet, 2-positive-seating check valve for continuous pressure application, and four test cocks. Assemblies shall be rated for working pressure of 1034 kPa 150 psi The maximum pressure loss shall be 40 kPa (6 psi) at a flow rate equal to the sprinkler water demand, at the location of the assembly. A test port for a pressure gauge shall be provided both upstream and downstream of the double check backflow prevention assembly valves.

PART 3 EXECUTION

3.1 FIRE PROTECTION RELATED SUBMITTALS

The Fire Protection Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful installation of the sprinkler systems(s). The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the Fire Protection Specialist when submitted to the Government.

3.2 INSTALLATION REQUIREMENTS

The installation shall be in accordance with the applicable provisions of NFPA 13, NFPA 24 and publications referenced therein. Installation of in-rack sprinklers shall comply with applicable provisions of NFPA 230.

3.3 INSPECTION BY FIRE PROTECTION SPECIALIST

The Fire Protection Specialist shall inspect the sprinkler system periodically during the installation to assure that the sprinkler system is being provided and installed in accordance with the contract requirements. The Fire Protection Specialist shall witness the preliminary and final tests, and shall sign the test results. The Fire Protection Specialist, after completion of the system inspections and a successful final test, shall certify in writing that the system has been installed in accordance with the contract requirements. Any discrepancy shall be brought to the attention of the Contracting Officer in writing, no later than three working days after the discrepancy is discovered.

3.4 ABOVEGROUND PIPING INSTALLATION

3.4.1 Protection of Piping Against Earthquake Damage

The system piping shall be protected against damage from earthquakes. Seismic protection shall include flexible and rigid couplings, sway bracing, seismic separation assemblies where piping crosses building seismic separation joints, and other features as required by NFPA 13 for protection of piping against damage from earthquakes.

3.4.2 Piping in Exposed Areas

Exposed piping shall be installed so as not to diminish exit access widths, corridors or equipment access. Exposed horizontal piping, including drain piping, shall be installed to provide maximum headroom.

3.4.3 Piping in Finished Areas

In areas with suspended or dropped ceilings and in areas with concealed spaces above the ceiling, piping shall be concealed above ceilings. Piping shall be inspected, tested and approved before being concealed. Risers and similar vertical runs of piping in finished areas shall be concealed.

3.4.4 Pendent Sprinklers

Drop nipples to pendent sprinklers shall consist of minimum 25 mm (1 inch) pipe with a reducing coupling into which the sprinkler shall be threaded. Hangers shall be provided on arm-overs to drop nipples supplying pendent sprinklers when the arm-over exceeds 300 mm (12 inches). Where sprinklers are installed below suspended or dropped ceilings, drop nipples shall be cut such that sprinkler ceiling plates or escutcheons are of a uniform depth throughout the finished space. The outlet of the reducing coupling shall not extend more than 25 mm (1 inch) below the underside of the ceiling. On pendent sprinklers installed below suspended or dropped ceilings, the distance from the sprinkler deflector to the underside of the ceiling shall not exceed 100 mm (4 inches). Recessed pendent sprinklers shall be installed such that the distance from the sprinkler deflector to the underside of the ceiling shall

not exceed the manufacturer's listed range and shall be of uniform depth throughout the finished area.

3.4.4.1 Pendent Sprinkler Locations

Pendent sprinklers in suspended ceilings shall be a minimum of 150 mm (6 inches) from ceiling grid.

3.4.5 Upright Sprinklers

Riser nipples or "sprigs" to upright sprinklers shall contain no fittings between the branch line tee and the reducing coupling at the sprinkler. Riser nipples exceeding 750 mm (30 inches) in length shall be individually supported.

3.4.6 Pipe Joints

Pipe joints shall conform to NFPA 13, except as modified herein. Not more than four threads shall show after joint is made up. Welded joints will be permitted, only if welding operations are performed as required by NFPA 13 at the Contractor's fabrication shop, not at the project construction site. Flanged joints shall be provided where indicated or required by NFPA 13. Grooved pipe and fittings shall be prepared in accordance with the manufacturer's latest published specification according to pipe material, wall thickness and size. Grooved couplings and fittings shall be from the same manufacturer.

3.4.7 Reducers

Reductions in pipe sizes shall be made with one-piece tapered reducing fittings. The use of grooved-end or rubber-gasketed reducing couplings will not be permitted. When standard fittings of the required size are not manufactured, single bushings of the face type will be permitted. Where used, face bushings shall be installed with the outer face flush with the face of the fitting opening being reduced. Bushings shall not be used in elbow fittings, in more than one outlet of a tee, in more than two outlets of a cross, or where the reduction in size is less than 15 mm (1/2 inch).

3.4.8 Pipe Penetrations

Cutting structural members for passage of pipes or for pipe-hanger fastenings will not be permitted. Pipes that must penetrate concrete or masonry walls or concrete floors shall be core-drilled and provided with pipe sleeves. Each sleeve shall be Schedule 40 galvanized steel, ductile iron or cast iron pipe and shall extend through its respective wall or floor and be cut flush with each wall surface. Sleeves shall provide required clearance between the pipe and the sleeve per NFPA 13. The space between the sleeve and the pipe shall be firmly packed with mineral wool insulation. Where pipes penetrate fire walls, fire partitions, or floors, pipes shall be fire stopped in accordance with Section 07840 FIRESTOPPING. In penetrations that are not fire-rated or not a floor penetration, the space between the sleeve and the pipe shall be sealed at both ends with plastic waterproof cement that will dry to a firm but pliable mass or with a mechanically adjustable segmented elastomer seal.

3.4.9 Escutcheons

Escutcheons shall be provided for pipe penetration of ceilings and walls. Escutcheons shall be securely fastened to the pipe at surfaces through which piping passes.

3.4.10 Inspector's Test Connection

Test connection shall locate at riser with UL listed site glass flow device ; a test valve located approximately 2 meters (7 feet) above the floor; a smooth bore brass outlet equivalent to the smallest orifice sprinkler used in the system; and a painted metal identification sign affixed to the valve with the words "Inspector's Test." The discharge orifice shall be located outside the building wall directed so as not to cause damage to adjacent construction or landscaping during full flow discharge.

3.4.11 Drains

Main drain piping shall be provided to discharge at a safe point outside the building, unless otherwise indicated, and shall be installed in a manner such that no damage will occur to adjacent construction or landscaping during full flow discharge. Auxiliary drains shall be provided as required by NFPA 13. All drain valves shall have plugs. Where branch lines terminate at low points and form trapped sections, such branch lines shall be manifolded to a common drain line.

3.4.12 Installation of Fire Department Connection

Connection shall be mounted on the exterior wall approximately 900 mm (3 feet) above finished grade. The piping between the connection and the check valve shall be provided with an automatic drip in accordance with NFPA 13 and arranged to drain to the outside.

3.4.13 Identification Signs

Signs shall be affixed to each control valve, inspector test valve, main drain, auxiliary drain, test valve, and similar valves as appropriate or as required by NFPA 13. Hydraulic design data nameplates shall be permanently affixed to each sprinkler riser as specified in NFPA 13.

3.5 UNDERGROUND PIPING INSTALLATION

The fire protection water main shall be laid, and joints anchored, in accordance with NFPA 24. Minimum depth of cover shall be 900 mm (3 feet). The supply line shall terminate inside the building with a flanged piece, the bottom of which shall be set not less than 150 mm (6 inches) above the finished floor. A blind flange shall be installed temporarily on top of the flanged piece to prevent the entrance of foreign matter into the supply line. A concrete thrust block shall be provided at the elbow where the pipe turns up toward the floor. In addition, joints shall be anchored in accordance with NFPA 24 using pipe clamps and steel rods from the elbow to the flange above the floor and from the elbow to a pipe clamp in the horizontal run of pipe. Buried steel components shall be provided with a corrosion protective coating in accordance with AWWA C203. Piping more than 1500 mm (5 feet) outside the building walls shall meet the requirements of Section 02510 WATER DISTRIBUTION SYSTEM.

3.6 EARTHWORK

Earthwork shall be performed in accordance with applicable provisions of Section 02315 EXCAVATION, FILLING AND BACKFILLING FOR BUILDINGS.

3.7 ELECTRICAL WORK

Alarm signal wiring connected to the building fire alarm control system shall be in accordance with Section 13850 Fire Alarm and Detection system, Direct Current Loop and Section 13851 Fire Alarm Reporting System, Radio Type. All wiring for supervisory and alarm circuits shall be #14 AWG solid copper installed in metallic tubing or conduit. Wiring color code shall remain uniform throughout the system.

3.8 DISINFECTION After all system components are installed and hydrostatic test(s) are successfully completed, each portion of the sprinkler system to be disinfected shall be thoroughly flushed with potable water until all entrained dirt and other foreign materials have been removed before introducing chlorinating material. Flushing shall be conducted by removing the flushing fitting of the cross mains and of the grid branch lines, and then back-flushing through the sprinkler main drains. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the sprinkler piping at a constant rate of 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or liquid chlorine injected into the system through a solution-fed chlorinator and booster pump shall be used. Chlorination application shall continue until the entire system is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system shall be opened and closed several times to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. The system shall then be flushed with clean water until the residual chlorine is reduced to less than one part per million. Samples of water in disinfected containers for bacterial examination will be taken from several system locations which are approved by the Contracting Officer. Samples shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method shall be either the multiple-tube fermentation technique or the membrane-filter technique. The disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained. After successful completion, verify installation of all sprinklers and plugs and pressure test the system.

3.9 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.10 PRELIMINARY TESTS

The system, including the underground water mains, and the aboveground piping and system components, shall be tested to assure that equipment and components function as intended. The underground and aboveground interior piping systems and attached appurtenances subjected to system working pressure shall be tested in accordance with NFPA 13 and NFPA 24. Upon completion of specified tests, the Contractor shall complete certificates as specified in paragraph SUBMITTALS.

3.10.1 Underground Piping

3.10.1.1 Flushing

Underground piping shall be flushed in accordance with NFPA 24. This includes the requirement to flush the lead-in connection to the fire protection system at a flow rate not less than the calculated maximum water demand rate of the system.

3.10.1.2 Hydrostatic Testing

New underground piping shall be hydrostatically tested in accordance with NFPA 24. The allowable leakage shall be measured at the specified test pressure by pumping from a calibrated container. The amount of leakage at the joints shall not exceed 1.89 liters (2 quarts) per hour per 100 gaskets or joints, regardless of pipe diameter.

3.10.2 Aboveground Piping

3.10.2.1 Hydrostatic Testing

Aboveground piping shall be hydrostatically tested in accordance with NFPA 13 at not less than 1400 kPa (200 psi) or 350 kPa (50 psi) in excess of maximum system operating pressure and shall maintain that pressure without loss for 2 hours. There shall be no drop in gauge pressure or visible leakage when the system is subjected to the hydrostatic test. The test pressure shall be read from a gauge located at the low elevation point of the system or portion being tested.

3.10.2.2 Backflow Prevention Assembly (BPA's) Testing

Backflow preventer assemblies shall be tested by a Washington State certified BPA tester. The tester shall complete the attached form (13930-BPA-Form) and shall submit the original signed form, plus a copy of the completed form in electronic format. Backflow preventer assemblies shall be installed by certified, licensed installers. No reduced pressure type BPA's are to be used. Installation of BPA shall include flushing.

3.10.3 Testing of Alarm Devices

Each alarm switch shall be tested by flowing water through the inspector's test connection. Each water-operated alarm devices shall be tested to verify proper operation.

3.10.4 Main Drain Flow Test

Following flushing of the underground piping, a main drain test shall be made to verify the adequacy of the water supply. Static and residual pressures shall be recorded on the certificate specified in paragraph SUBMITTALS. In addition, a main drain test shall be conducted each time after a main control valve is shut and opened.

3.11 FINAL ACCEPTANCE TEST

Final Acceptance Test shall begin only when the Preliminary Test Report has been approved. The Fire Protection Specialist shall conduct the Final Acceptance Test and shall provide a

complete demonstration of the operation of the system. This shall include operation of control valves and flowing of inspector's test connections to verify operation of associated waterflow alarm switches. After operation of control valves has been completed, the main drain test shall be repeated to assure that control valves are in the open position. In addition, the representative shall have available copies of as-built drawings and certificates of tests previously conducted, and related system documentation. The installation shall not be considered accepted until identified discrepancies have been corrected and test documentation is properly completed and received.

3.12 ON-SITE TRAINING

The Fire Protection Specialist shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 16 hours of normal working time and shall start after the system is functionally complete but prior to the Preliminary Tests and Final Acceptance Test. The On-Site Training shall cover all of the items contained in the approved Operating and Maintenance Instructions.

END OF SECTION

SECTION 14240

ELEVATORS, HYDRAULIC

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999e) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 176	(1999) Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 366/A 366M	(1997e) Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality
ASTM A 568/A 568M	(1998e) Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled
ASTM A 569/A 569M	(1998) Commercial Steel (CS) Sheet and Strip, Carbon (0.15 Maximum Percent), Hot-Rolled
ASTM D 92	(1998a) Flash and Fire Points by Cleveland Open Cup (IP36/84(89))
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials

ASME INTERNATIONAL (ASME)

ASME A17.1	(1998a) Safety Code for Elevators and Escalators
ASME A17.2.2	(1998) Inspectors' Manual for Hydraulic Elevators
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B31.1	(1998) Power Piping
ASME QE1-1	(1997) Standard for the Qualification of Elevator Inspectors

CODE OF FEDERAL REGULATIONS (CFR)

36 CFR 1191 Americans with Disabilities Act (ADA) Accessibility
Guidelines for Buildings and Facilities

ENGINEERING TECHNICAL INSTRUCTIONS AND ENERGY SAVINGS ANALYSIS

TI 809-04 (1998) Seismic Design for Buildings

FEDERAL STANDARDS (FED-STD)

FED-STD 795 (Basic) Uniform Federal Accessibility Standards

INTERNATIONAL CODE COUNCIL (ICC)

IBC (2000) International Building Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA LD 3 (1995) High-Pressure Decorative Laminates

NEMA MG 1 (1998) Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (1999) National Electrical Code

NFPA 101 (2000) Life Safety Code

NFPA 252 (1999) Fire Tests of Door Assemblies

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-01 Data

Training Data;

Information describing the training course for operating personnel, training aids and samples of materials to be used, training schedules, and notification of training.

Elevator System; G

A complete list of equipment and material, including illustrations, schedules, manufacturer's descriptive data and technical literature, performance charts, catalog cuts, installation instructions, brochures, diagrams, and other information required for fabrication and installation of the equipment. Data shall include calculations for reaction loads imposed on

building by elevator systems and to demonstrate that the proposed elevator system conforms to paragraph SEISMIC REQUIREMENTS. Certified copies of list reports may be submitted in lieu of calculations. Calculations to demonstrate compliance with ASME A17.1, Rule XXIV shall be included. Spare parts data for each different item of material and equipment specified, after approval of detail drawings and not later than 2 weeks prior to date of beneficial occupancy. Data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of parts recommended for replacement and the replacement interval required. Data shall include appropriate sizing of electrical protective devices.

SD-04 Drawings

Elevator System; G

Detail drawings including dimensioned layouts in plan and elevation showing the arrangement of elevator equipment, anchorage of equipment, clearances for maintenance and operation; and details on hoistway, doors and frames, operation and signal stations, controllers, motors, guide rails and brackets, cylinder and plunge unit, and points of interface with normal power, fire alarm system HVAC or exhaust systems and interface with emergency power systems. Drawings shall show any revised building electrical system required to make supplied elevator system function as specified. Drawings shall contain complete wiring diagrams showing electrical connections and other details required to demonstrate sequence of operation and functions of system devices. Drawings shall include the appropriate sizing of electrical protective devices that are frequently different from National Electrical Code standard sizes. Drawings shall include an elevation view of elevator controls and communication devices as intended for installation.

SD-06 Instructions

Framed Instructions; G

Diagrams, instructions, and other sheets proposed for posting.

SD-08 Statements

Qualification Certificates; G

Certificates of experience of elevator mechanics employed to install, supervise and test the elevator shall certify mechanics to have not less than 5 years experience installing, supervising and testing elevators of the type and rating specified. Certificate shall certify that elevator system installer is acceptable to elevator manufacturer prior to installation of elevators.

SD-09 Reports

Testing; G

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of installed system.

SD-14 Samples

Finishes. G

Samples of materials and products requiring color or finish selection.

SD-18 Records

Test Procedures; G

A plan detailing the testing procedures shall be submitted 30 days prior to performing the elevator tests.

SD-19 Operation and Maintenance Manuals

Elevator System; G.

Six copies of operation manual outlining the step-by-step procedures for system startup, operation and shutdown. Manuals shall include manufacturer's name, model number, service manual, parts list and brief description of all equipment, including basic operating features. Six copies of maintenance manual listing routine maintenance procedures, possible breakdowns and repairs, and troubleshooting guides. Manuals shall include equipment layout and complete wiring and control diagrams of the system as installed. Operation and maintenance manuals shall be approved prior to training course.

1.3 QUALIFICATIONS

Hydraulic elevators shall be pre-engineered elevator systems, and provided by a company regularly engaged in the manufacture of elevator systems. The manufacturer shall either install the elevator system or provide letter of endorsement certifying that the elevator-system installer is acceptable to the manufacturer.

1.4 REGULATORY REQUIREMENTS

Design and fabrication shall be in accordance with ASME A17.1. Each car shall have the capacity to lift a live load, exclusive of the car, at a speed as specified in the following schedule. The approximate travel, terminal floors, number of stops and openings, and the car sizes shall be as shown in the schedule. The elevators shall serve the floors with stops and openings in accordance with the requirements indicated. Elevators shall provide accessibility and usability for physically handicapped in accordance with the requirements for the handicapped in FED-STD 795 and 36 CFR 1191.

1.4.1 Elevator Schedule (Passenger)

Number Required: 1 at Large Battalion HQ

Service: Passenger

Capacity: 907 kg (2000 pound)

Speed:	0.50 m/s full load up 0.75 m/s down speed
Platform Size:	2 134 mm wide by 1 500 mm deep
Clear Car Inside:	2 032 mm wide by 1 295 mm deep
Net Travel:	4 300 mm
Landings:	2
Openings: Front	914 mm x 2 134 mm
Openings: Rear	n/a
Entrance Type:	Horizontal-sliding/side opening

1.5 DESIGNATED LANDING

For the purposes of firefighter's service and emergency operations, as required by Section 211, ASME A17.1, the designated landing or level shall be the first floor. The alternate landing or level shall be the second floor.

1.6 DELIVERY AND STORAGE

All equipment delivered and placed in storage shall be stored with protection from the weather, excessive humidity and excessive temperature variations; and dirt, or other contaminants.

1.7 FIELD MEASUREMENTS

The Contractor shall become familiar with all details of the work, verify all dimensions in the field and advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall be specifically responsible for the conditions and proper relation of this work to the building structure and to the work of other trades. Elevator shall be approved prior to the initiation of construction of the elevator shaft structure. Revisions to structural dimensions due to changes in the size of the elevator are the responsibility of the Contractor.

1.8 HOISTWAY FRAMING

Contractor shall be responsible for all structural and non-structural support and guide framing within the elevator hoistways as required for the complete installation and operation of the elevator systems. All such framing not designed as part of this contract shall be designed by the Contractor.

1.9 WARRANTY

Warranty service shall be provided for each elevator for a period of 12 months after date of acceptance by Contracting Officer. Warranty service shall be performed only by trained elevator mechanics during regular working hours and shall include manufacturer's warranty requirements including but not limited to adjusting, lubricating and cleaning of equipment and

furnishing supplies and parts to keep elevator in operation, except such parts made necessary by misuse, accident or negligence not caused by the Contractor. Testing and adjustments shall be in accordance with the applicable provisions of ASME A17.1 and ASME A17.2.2. Emergency callback service shall be included and available 24 hours a day, 7 days per week, with an initial telephone response time of 1 hour and a response time of not more than 24 hours for a mechanic to the site. Inspection and service for fire service operation and seismic requirements shall be performed every 3 months (a total of four during the warranty period). Documentation of inspection and testing, and certification of successful operation shall be provided with each unit.

1.10 CONTRACTOR QUALITY CONTROL

The Contractor shall establish and maintain a quality control procedure to assure compliance of hydraulic elevators with the contract requirements. Any work found not to be in compliance with the contract shall be promptly removed and replaced, or corrected in an approved manner. Quality control shall include, but not be limited to, the following:

- (1) Storage and handling of materials.
- (2) Inspection of materials and equipment delivered to the project site against approved material data.
- (3) Shop drawings include explicit identification of coordination with other trades.
- (4) Verification of the location and plumb of the elevator plunger holes.
- (5) Verification of the plumb and general suitability of elevator hoistway preparatory to elevator installation.
- (6) Verification that installed operating variables are within all specified and manufacturer's listed tolerances, clearances and speeds.
- (7) Proper function and operability of the elevators after installation.
- (8) Protection of elevators following installation and replacement or repair of all damaged components.

The actual quality control observations and inspections shall be documented and a copy of the documentation furnished to the Contracting Officer within 24 hours following the observations, inspections, or tests.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

2.1.1 Standard Products

Material and equipment shall be the standard products of manufacturers regularly engaged in the fabrication of elevators and/or elevator parts, and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be

supported by a service organization that is available 24 hours a day, 7 days per week, with a response time of not more than 24 hours.

2.1.2 Nameplates

Each major item of equipment shall have the manufacturer's name, address, type or style, model or serial number, catalog number, and electrical and mechanical characteristics on a plate secured to the item of equipment.

2.1.3 Special Tools

One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance of the equipment shall be provided.

2.1.4 Electrical Work

Changes to the electrical distribution system required for coordination with elevator equipment shall be performed and coordinated by Contractor, at Contractor's expense. Electrical service for elevator machines shall be 480 volt, 60-Hertz, 3-phase, 3 wire ungrounded alternating current. Electric service for elevator car lighting shall be 120-volt, single-phase, 60-Hertz grounded service. Electrical work shall conform to requirements in SECTION: ELECTRICAL WORK, INTERIOR. A disconnect switch that will shut off power to the elevator car lighting shall be provided in the elevator machine room adjacent to the elevator control panel. A telephone junction box and an elevator car lighting junction box shall be provided adjacent to each controller. A single-phase electric circuit with grounded connection for video monitor shall be provided in machine room.

2.1.5 Use of Asbestos Products

Materials and products required for manufacturing and installing elevators shall not contain asbestos.

2.2 MISCELLANEOUS MATERIALS

2.2.1 Materials for Car Enclosures

Materials for car enclosures shall meet flame spread rating 0 to 75 and smoke development 0 to 450 as tested in accordance with requirements of ASTM E 84 as established by ASME A17.1, Rule 204.2.

2.2.2 Structural Steel

Structural steel shall be hot-rolled commercial quality carbon steel, pickled, oiled, complying with ASTM A 569/A 569M and ASTM A 568/A 568M.

2.2.3 Cold-Rolled Sheet Steel

Sheet steel shall be cold-rolled commercial quality low carbon steel, Class 1, exposed matte finish, oiled, complying with ASTM A 366/A 366M and ASTM A 568/A 568M.

2.2.4 Stainless Steel

Stainless steel shall be ASTM A 176 Type 302/304, austenitic, corrosion-resistant, with grain of belting in the direction of longest dimension. Surfaces shall be smooth and without waves and shall be in compliance with ASTM A 366/A 366M.

2.3 PASSENGER ELEVATOR CAR

2.3.1 Car Fronts

Fronts for passenger elevators shall be combination door post and return panels manufactured of 1.9837 mm thick (14 gauge) stainless steel provided with necessary cutouts for operating devices. Car operating panel shall be recessed into front return panel with surface-applied operating panel cover. Position indicator in front return shall be recessed with a surface-applied cover plate. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified.

2.3.2 Car Doors

Car doors for passenger elevators shall be constructed from 1.519 mm thick (16 gauge) sheet steel and stainless steel cladding. Each door shall be sound-deadened and reinforced to receive required operating mechanism and hardware, and have two removable door guides per panel. Seams, screws or binding strips shall not be visible from within the car. Threshold shall be extruded aluminum with grooves for door guides. Exposed stainless steel shall be finished with No. 4 Satin Finish, unless otherwise specified. Car doors shall be equipped with a proximity-type infrared protective device having the following operation:

- a. When doors are in full-open position, doors shall be unable to initiate closing if a person comes within detection zone. Detection zone moves with doors, so that if a passenger or object enters the zone after doors have begun to close, doors shall stop, then reverse to reopen. Doors shall reclose after a brief time. A passenger entering or leaving cars shall not cause doors to reopen unless doors reach a predetermined proximity to passenger.
- b. After a stop is made, doors shall remain open for a time to permit passenger transfer, after which doors shall close automatically. This time interval shall be less for a car call than for a hall call or a coincident car/hall call.
- c. If there is either a hall call anywhere in the group or a car call in the car in question and doors are prevented from closing for a fixed time period, a buzzer shall sound in car. Normal door operation shall resume at next landing reached by car.

2.3.3 Car Platform

Car platform for passenger elevators shall be fabricated from steel plates secured to a steel frame or plywood secured to a steel frame. Steel car platforms shall be assembled into a one-piece platform with top and bottom steel plates welded to structural steel frame and covered with felt and sound-isolation. Plywood car platform shall be 18 mm thick Exposure 1 plywood secured to underside of structural steel frame with metal fire protection secured to underside of structural steel frame.

2.3.4 Sling

Sling for passenger elevators shall be constructed of heavy steel stiles properly affixed to a steel crosshead and bolster with adequate bracing members to remove all strain from car enclosure. Steel bumpers shall be furnished for fastening sling to plunger.

2.3.5 Walls

Walls for passenger elevators shall be 2 426 mm (high from floor to the underside of lighting fixtures. Side and rear panels shall be 1.519 mm thick (16 gauge) sheet steel panels. Side and rear removable panels shall be applied to car walls and shall be manufactured from 18 mm plywood or composition board finished on front, back and edges with plastic laminate conforming to NEMA LD 3, general purpose type. Panels shall be mounted on car walls in a manner permitting their reversing. Panels shall be evenly spaced with not less than two panels on each side and three panels at rear with reveal standard with manufacturer. Vent around base shall be provided.

2.3.6 Car Top, Ceiling and Light Fixtures

Car top for passenger elevators shall be manufactured from 2.657 mm thick (12 gauge) sheet steel and shall be not less than 140 mm high with drop-ceiling and light fixtures. Ceiling shall be 3 mm thick egg crate white plastic fire-retardant light diffuser supported by polished aluminum perimeter frame and dividers to form drop-ceiling light fixture. Light fixtures shall be fluorescent type flush with car ceiling, manufactured of sheet steel with flange and enclosed sides and top, baked-enamel reflector, mounted directly to outlet box. Bottom of fixtures shall be flush with car ceiling. Fluorescent light fixtures shall be dual lamp with quick-starting high-power factor, Class P ballasts with safety lamp guard clamps on fluorescent tubes. Light level shall average at least 108 lx (10 foot-candles) measured at the car threshold, with the door closed. A part of car light fixture shall be removable to permit use of the emergency exit panel in top of car.

2.3.7 Emergency Exit

Car top for passenger elevators shall be manufactured with a hinged emergency exit panel of 2.657 mm thick (12 gauge) steel which opens up to clear the crosshead and car door operator. Emergency exit panel shall be hinged on counterweight side and held in place with nonremovable fastening devices at each corner, and be openable from top of car only. A minimum of two sides of exit panel shall lap exit opening by 25 mm. Exits shall be equipped with electrical contacts which will prevent operation of car when the exit door is open and cause the alarm bell to ring.

2.3.8 Floor Finish

Floor finish for passenger elevators shall be finished with resilient tile flooring not less than 5 mm thick or flexible type homogeneous vinyl tile not less than 3 mm thick as specified in SECTION RESILIENT FLOORING. Tile shall be laid flush with the extruded aluminum platform threshold.

2.3.9 Base

Base for passenger elevators shall be plastic laminate, 150 mm high.

2.3.10 Handrails

Handrails for passenger elevators shall be mounted on each wall and shall comply with ASME A17.1, FED-STD 795 and 36 CFR 1191. For elevators with two-speed horizontal-slide openings, handrails shall be turned back to wall.

2.3.11 Exhaust Fan

Exhaust fan for passenger elevators shall be two-speed exhaust type ventilating unit mounted in car ceiling and shall be provided with a stainless steel grille. Units shall be suitably isolated from car ceiling and shall provide at top speed of a minimum of 6 air changes per hour for car volume and car occupancy. Switches for the operation of the exhaust unit shall be located in car station locked cabinet or key-switched.

2.3.12 Communications

A telephone system in stainless steel cabinets shall be provided for passenger elevators. A vandal-resistant speaker type intercom with push-buttons to activate shall be installed in car station behind a stainless steel perforated grille and connected to a programmable auto-dialer located in machine room. Auto-dialer shall be provided with a solid-state charger unit, which will automatically provide emergency power and an immediate transfer in the event of failure of normal power supply. The push-button located in car station or in separate cabinet shall be at the prescribed height for access by the disabled and shall be identified as "EMERGENCY PHONE PUSH TO ACTIVATE". The entire communication assembly shall be approved for an elevator installation. The push button telephone shall comply with FED-STD 795 and 36 CFR 1191. The telephone communication shall not be terminated until one of the communicating parties hangs up the receiver or manually disconnects the communication link. Auto-dialer shall connect to on post 24-hour emergency number, verify number with Ft. Lewis Emergency Services.

2.3.13 Car Emergency Lighting System

Emergency car lighting system for passenger elevators shall consist of an emergency power pack on top of the elevator and a remote lighting fixture inside elevator car located above car operating panel.

2.3.13.1 Power Pack

Power pack for emergency lighting system shall be a sealed lead-cadmium or nickel-cadmium 6-volt rechargeable batteries with solid-state controls and an integral regulating charger connected to normal power supply. Power pack unit shall contain the following:

- a. Minimum 150 mm diameter alarm bell connected to the elevator alarm and emergency push-button.
- b. Top of car light fixture with protective wire guard.
- c. Testing circuit and pilot light.
- d. Low-wattage pilot light indicator.

- e. Battery low-voltage disconnect.

2.3.13.2 Emergency Light Fixture

Emergency light fixture shall be located in car station inside elevator car, with flush-mounted lens and shall consist of the following:

- a. A minimum of two lamps capable of providing a minimum level of illumination of 10.8 lx (1.0 foot-candle) at a point 1220 mm above the floor, 300 mm (in front of car station).
- b. Steel fixture frame with chrome finish.
- c. Frosted acrylic lens, 6 mm.

2.3.13.3 Remote Light Fixture

Upon interruption of normal power, remote light fixture for passenger elevators shall automatically and immediately illuminate and permit operation of alarm bell, subject to activation of emergency stop-switch or alarm button. Emergency power pack shall be capable of providing a minimum of 1-hour emergency bell operation and 12 hours of continuous illumination.

2.3.14 Protection Pads

Car shall be provided with wall protection pads with inconspicuous stainless steel pad hooks spaced not over 460 mm apart near the ceiling. Pads shall be heavy-quality fire-retardant treated canvas with two layers of sewn cotton batting with metal eyelets for each pad hook. Pads shall cover entire wall surface except operating devices. Pads shall be flame retardant in accordance with ASME A17.1, Rule 204.2.

2.3.15 Certificate Frame

A stainless steel certificate frame with translucent Plexiglas lens of the appropriate size to receive certificate issued by inspecting agency shall be provided. Frame shall be engraved to show name of manufacturer, carrying capacity in kilograms) and pounds and maximum number of persons allowed.

2.3.16 Car Guide Shoes

Guide shoes for passenger elevators shall be the adjustable mounting type on each side of car. Shoes shall be rigidly secured in accurate alignment at top and bottom of car frame. Flexible type sliding guide shoes shall consist of a swivel-type shoe, assembled on a metal base with provisions for self-alignment. Each shoe shall be provided with renewable gibs. Car guide shoes shall be adjustable for side play between guide rails. Renewable wearing gibs shall be fabricated from a durable plastic compound material having a low coefficient of friction and long wearing qualities. Gibs shall be the type requiring minimum rail lubrication.

2.4 PASSENGER ELEVATOR HOISTWAY ENTRANCES

2.4.1 Hoistway Doors

Hoistway doors for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Doors for passenger elevators shall be hollow metal type with plain panel design not less than 32 mm thick with 1.519 mm thick (16 gauge) face sheet-steel panels, and stainless steel cladding, with 1.519 mm thick (16 gauge) sight guards to match door finish. Each door shall be reinforced with continuous vertical members and filled with sound-deadening material. Doors shall be reinforced to accept the required operating mechanism and hardware. Doors shall have two removable door guides per panel. Seams, binding strips or screws shall not be visible from the landing. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified.

2.4.2 Hoistway Frames

Hoistway frames for passenger elevators shall be designed and fabricated as part of a Class B 1-1/2 Hour fire-rated door/frame assembly to meet requirements of NFPA 252 and shall bear the label of an approved testing laboratory. Frames shall be formed 1.897 mm thick (14 gauge) sheet-steel with head and jamb in flush alignment and corners welded and ground smooth. Head and jamb section shall be bolted assembly with bolts, washer and locking nut or lock washer. Frame assembly shall be securely fastened to the structure. Frames shall return to the wall. Combination buck and jamb frames may be provided with knockdown back flanges to permit installation in concrete walls. Exposed steel shall be finished with rust-inhibitive primer and baked-enamel in a color to be selected, unless otherwise specified.

2.4.3 Symbols

Raised stainless steel symbols as required by FED-STD 795 and 36 CFR 1191 of color selected, shall be provided at each floor to indicate the floor location. Symbols shall be attached with concealed fasteners. Symbols shall be placed in a location that can be seen by passenger from the opened passenger elevator doors.

2.4.4 Sills

Sills for passenger elevators shall be extruded aluminum with slip-resistant surface and machined grooves for door guides, secured to floor beams.

2.4.5 Strut Angles

Strut angles for passenger elevators shall be structural steel of size not less than 76 x 76 x 5 mm extending from sill to beam above and anchored to building structure with structural steel fastenings and bracings of structural members with a cross section of not less than strut angles.

2.4.6 Door Hangers and Housing

Each door panel shall be provided with not less than two sheave-type hangers designed for required door operation. Hanger housing and support shall be fabricated from formed Z-shaped steel angles of size not less than 5 mm thick bolted to strut angles.

2.4.7 Door Rollers

Door rollers shall be constructed with grease-packed ball bearings and shall be tired with a sound-reducing material. Diameter of rollers shall not be less than 83 mm for car doors and not less than 57 mm for hoistway doors. Upward thrust shall be taken by a hardened and ground ball-bearing roller assembled on an eccentric stud to provide adjustment.

2.4.8 Hanger Track

Hanger track shall be of high carbon cold-drawn steel, round at top to receive door rollers, round at bottom to receive up-thrust rollers, of size engineered to accommodate load requirements.

2.4.9 Covers and Guards

Hanger covers, dust covers, toe guards and fascia plate shall be fabricated from 1.519 mm thick (16 gauge) reinforced steel and finished with baked-enamel. Hanger covers shall extend the full door travel and shall be mounted in sections for ease of servicing door hangers. Dust covers shall be provided over top terminal landing door only and shall be secured to hanger housing and building structure. Toe guards shall be secured to sill. Fascia plates shall be provided between each door hanger housing and sill.

2.5 PASSENGER ELEVATOR DOOR OPERATION

Car and hoistway doors for passenger elevators shall be operated simultaneously by an electric-power door operator. Doors shall operate smoothly in the opening direction and closing direction and be electrically or hydraulically cushioned to stop at both the full-open and full-closed position. Operators shall be high-speed heavy-duty type that will provide an average door-opening speed of 0.76 m/s (2-1/2 fps). Car and hoistway doors shall be opened and closed simultaneously in a maximum time of 6 seconds. When on automatic operation door-closing time shall not exceed 3.5 seconds and door-closing force shall not exceed 130 N (30 pounds). Reversal of doors when closing shall be accomplished by the "DOOR OPEN" button, car door safety edge, or interruption of the photoelectric light beams. Doors shall be arranged so that doors can be opened manually in the event of power failure.

2.6 PASSENGER ELEVATOR OPERATING AND SIGNAL FIXTURES

2.6.1 General

Elevator fixtures and panels for passenger elevators shall be constructed of 3 mm thick faceplates of stainless steel. Fastenings for all exposed fixtures shall be secured with tamper-proof spanner-head screws of same material and finish as fixture. Hall and car call-buttons shall be the call-register type with a low-voltage power supply not to exceed 48 volts. Pressure on a button shall illuminate button to indicate that a call in the desired direction has been registered. Car and hall fixtures shall be designed and located at the prescribed height

to accommodate passengers with disabilities in accordance with FED-STD 795 and 36 CFR 1191 for passenger elevators only. Markings included for the disabled shall be integral with faceplates in accordance with FED-STD 795 and 36 CFR 1191. Surface-applied markings are not acceptable. Engraving shall be black-filled except for fire-service identification which shall be red-filled. Operating and signal fixture contacts and lamps shall be completely enclosed in steel boxes finished with a baked-enamel coating. Boxes for hall landing devices shall be equipped for proper adjustment to wall. Lamps shall be installed in light-tight compartments. Cover-plates shall be provided with rubber gaskets when exposed to weather or harmful contaminants. Replacement bulbs shall be readily available from three sources.

2.6.2 Car Operating Panel

Car operating panel for passenger elevators shall be provided with the necessary raised (0.8 mm) markings for the disabled, and shall include a series of minimum 20 mm diameter or square push-buttons numbered to correspond to the floor served and various additional switches, buttons and light jewels, including emergency stop, alarm button, "DOOR OPEN" button and communication speaker. Operating buttons shall be vandal-resistant metal encased and embossed to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm (operating clearance to set on faceplate in lieu of the button mechanism. Buttons shall have maximum protrusion of 5 mm beyond the faceplate and shall have beveled edges to prevent damage from side blows. Buttons and switches not required for automatic or fire-service operation shall be key-operated and mounted on front-return car operating station. Elevator number and "NO SMOKING" shall be international symbol engraved on upper portion of car. Operating panel in car shall consist of a flush-mounted panel containing the following operating devices:

- a. "DOOR OPEN" button.
- b. "DOOR CLOSE" button.
- c. Key-operated car fan/light switch.
- d. Key-operated ventilating blower switch/call light.
- e. Communication speaker phone, grille and push-to-call button.
- f. Emergency stop-switch key-operated when operated will stop the car independently of normal stopping devices. Operation of emergency stop switch shall not cause any power variance or surge that may affect the operation or condition of the control panel or its components.
- g. Emergency signal-switch connected to a 150 mm diameter signal bell outside of elevator hoistway at first floor located as shown or as directed.
- h. Key-operated independent operation switch.
- i. Key-operated inspection switch that will render normal operation inoperative for the purpose of using the hoistway access switch.
- j. Key-operated fire-service switch and light jewel.

2.6.3 Hall-Call Station

Hall-call operating devices for passenger elevators at landing shall consist of an "UP" push-button at bottom landing and a "DOWN" push-button at top landing. Buttons shall be vandal-resistant metal encased and back-lighted to permit illumination when a call is registered. Buttons shall be designed with 0.8 mm operating clearance to seat on faceplate in lieu of button mechanism. Buttons shall have maximum protrusion of 5 mm beyond faceplate with beveled edges to prevent damage from side blows.

2.6.3.1 Fire-Service Switch

Fire-service switch for passenger elevators shall be located at the designated landing. Coordinate cylinder and keying requirements for fire-service switch with Ft. Lewis Fire Marshal's office.

2.6.4 Direction Lanterns

Lanterns for passenger elevators shall be in accordance with FED-STD 795 and 36 CFR 1191 and shall be provided at all floor landings and in each car entrance column. Lanterns shall be the manufacturer's standard design. Lanterns shall signal the approach of a stopping car when car is a predetermined distance from landing.

2.6.5 In-Car Car-Position Indicator

Indicator numerals and directional arrows for passenger elevators shall be flush-mounted faceplate with black-filled engraved numerals not less than 25 mm (high and 10 mm diameter vandal-resistant light jewels directly beneath each number. As car travels through hoistway the car position shall be indicated by illumination of light jewel corresponding to landing at which the car is stopped or passing. Necessary light baffles shall be provided. Floor numerals and letters shall illuminate white. A position indicator of the digital-readout or dot-matrix type (minimum 50 mm high indication) shall be provided in car transom panel. Number corresponding to car position shall remain illuminated when motor drive is shut down. Illumination shall be shrouded in an approved manner to protect against glare from car lighting.

2.6.6 Audible Signals

An audible signal shall be provided at each floor landing and in each car and shall sound coincident with the lantern illumination indicators. The audible signal shall be no less than 20 decibels with a frequency no higher than 1500 Hz. The audible signal shall sound once for UP direction and twice for DOWN direction.

2.6.7 Combination Hall-Position Indicator and Directional Arrows

Combination hall-position indicator and directional arrows for passenger elevators shall be provided at first floor landing directly above entrance frame.] As elevator travels in hoistway, elevator position shall be indicated by illumination in alpha-numeric characters corresponding to the landing where elevator is stopped or passing. Number corresponding to position of car shall remain illuminated when motor is shut down. An audible signal shall sound in elevator car to indicate that the elevator is stopping or passing a floor served by elevator. Fixture design and operation shall be similar in design to that specified for Car Position Indicator.

2.7 PASSENGER CAR OPERATION (TWO-STOP AUTOMATIC CAR OPERATION)

The operating device at each hoistway landing shall consist of a single illuminating push-button. The system shall be designed for operating elevator from push-buttons at landings and car buttons marked for corresponding landings. Pressure on a car button or landing button shall dispatch or call the car to other landings if interlock circuits have been established. A call shall remain registered if a lower floor landing button is pressed while car is making an UPWARD trip. After car has reached upper landing and interlock circuits have been reestablished the car shall automatically reverse and respond to lower landing call. Elevator shall operate similarly for DOWN direction of travel. A time-limit relay shall be provided to hold the car for a predetermined period at landing where car stops. When all calls are completed the elevator shall park at lower floor. A landing button pressed momentarily at same floor at which the car is parked shall automatically open car and hoistway doors.

2.8 AUTOMATIC EMERGENCY POWER OPERATION

Elevator control system shall be arranged to operate on emergency battery power supply upon failure of the normal power supply. Emergency power supply shall consist of battery and battery chargers. Batteries shall be solid, no maintenance type, liquid filled batteries are unacceptable. Elevators operating on dedicated service, such as fire service, will not be required to return to first floor when emergency power becomes available for respective elevator. Elevators shall operate as follows:

- a. When normal power supply fails, car shall shut down.
- b. Car shall automatically start and travel at full-rated speed to designated landing, stop, open the car and hoistway doors and hold open until regular door time has expired. Elevator shall then become inactive.
- c. Upon restoration of normal power supply to the building, the elevator shall automatically resume normal operation.

2.9 AUTOMATIC ELEVATOR OPERATION

2.9.1 General

The operating device shall consist of a series of push-buttons in the car numbered to correspond to various landings, a single "UP" or "DOWN" button at terminal landings. To meet the elevator operation requirements specified in this section all buttons shall be connected electrically to the control system which governs the floor selection, car selection, direction of travel and governs the acceleration and retardation.

2.9.2 Operation

Car calls shall be registered within the car by pressing the button corresponding to the designated floors. Hall calls shall be registered by pressing buttons in the corridor push-button fixture. Once the demand for elevator service has been established and the car has received a start signal the car operation shall be as follows.

2.9.2.1 Door Closing

Doors shall close automatically. When doors are fully closed and the interlock circuit established, the car shall start to move in the direction established by control system. Car shall accelerate and decelerate automatically and stop at first floor for which a car button has been registered or at first floor for a corridor demand. Car shall stop at all floors for which car calls are registered in the order in which the floors are reached and shall stop for any corridor demands assigned to the cars in the order in which the floors are reached.

2.9.2.2 Door Opening

Doors shall open automatically as car reaches the landing. After a predetermined time the doors shall close and the car shall proceed to answer the remaining car or assigned corridor calls. A protective device such as a safety edge and light beam device shall be provided on car door and when activated will prevent closing of doors. Cars shall become available for assignment at whatever floor the last car demand has been satisfied in the direction in which the car is traveling.

2.9.2.3 Car Dispatch

When car does not receive a demand dispatch at dispatching floor for an adjustable time period up to 10 minutes, set initially at 5 minutes, the motor drive unit shall be switched-off. If the car's switched-off motor drive unit receives a demand dispatch the motor drive unit shall automatically restart.

2.9.2.4 Door Dwell-Time

Door open dwell-times shall be adjustable so that the open time for a car call is shorter than the open time for corridor calls and second passengers. If a longer time is needed for passenger entry, doors can be prevented from closing or reversing by the light beam door control, the protective leading edge on car door, or by pressing "DOOR OPEN" button in car. Door dwell-times shall comply with FED-STD 795 and 36 CFR 1191.

2.10 SENSOR AND CONTROL WIRE SURGE PROTECTION

Digital and analog inputs shall be protected against surges induced on control and sensor wiring. Digital and analog outputs shall be protected as shown against surges induced on control and sensor wiring installed outdoors. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.11 COMMUNICATIONS LINKS SURGE PROTECTION

Communications equipment shall be protected against surges induced on any communications link. Cables and conductors, except fiber optics, which serve as

communications links from Motor Control Room (MCR) to field equipment, and between field equipments shall have surge protection circuits installed at each end. Protection shall be furnished at equipment and additional triple electrode gas surge protectors rated for the application on each wireline circuit shall be installed within 1 m of the building cable entrance. Fuses shall not be used for surge protection. The inputs and outputs shall be tested in both normal mode and common mode using the following two waveforms:

- a. A 10 microsecond rise time by 1000 microsecond pulse width waveform with a peak voltage of 1500 volts and a peak current of 60 amperes.
- b. An eight microsecond rise time by 20 microsecond pulse width waveform with a peak voltage of 1000 volts and a peak current of 500 amperes.

2.12 COMMUNICATIONS LINKS OVER VOLTAGE PROTECTION

Communications equipment such as Modems, line drivers, and repeaters shall be protected against overvoltage on any communications link conductors. Cables and conductors, which serve as communications links, except fiber optics, shall have overvoltage protection for voltages up to 480 Vac rms, 60 Hz installed. Instrument fuses or fusible resistors are required for this application.

2.13 FIREFIGHTERS SERVICE

Firefighter service shall be in accordance with ASME A17.1 for automatic elevators. Elevator lobby and machine room smoke detectors shall be photoelectric spot-type smoke detectors. Smoke detectors shall be powered from the building fire alarm control panel. Elevator lobby and machine room smoke detectors shall be in accordance with SECTION: FIRE DETECTION AND ALARM SYSTEM, ADDRESSABLE

2.14 ELEVATOR POWER UNIT

2.14.1 Pumping and Control Mechanism

Hydraulic fluid shall be provided in the reservoir, pump and control valve. Hydraulic fluid shall have a minimum fire point of 190 degrees C (as established by ASTM D 92. If oil temperature drops below pre-set minimum, elevator shall be dispatched automatically to lowest terminal floor at which point the pump will bypass oil in system without car motion until pre-set temperature is reached. Normal response to passenger demand shall not be affected by this control. Resistance type heating elements do not meet the intent of this specification.

2.14.1.1 Oil Temperature Device

An oil temperature device shall be provided that will maintain oil temperature between 21 degrees C and 38 degrees C regardless of ambient temperatures.

2.14.1.2 Pump

Pump shall be a rotary-positive displacement type for oil-hydraulic elevator service designed for steady discharge with minimum pulsation to give smooth and quiet operation, with an output which will not vary more than 10 percent between no-load and full-load on the elevator. Operating pressure shall not exceed 2760 kPa (400 psi).

2.14.1.3 Piping

Piping shall be ASTM A 53/A 53M Grade E or S, ASTM A 106 Grade B, or grooved piping system of minimum schedule 40 seamless steel conforming to ASME A17.1 and ASME B16.11. Pipes shall conform to the cleanliness requirements of ASME B31.1.

2.14.1.4 Motor

Motor shall be especially designed for oil-hydraulic elevator service and shall be of standard manufacture duty rating and provided with specified speeds and loads.

2.14.1.5 Oil-Control Unit

Oil-control unit shall contain the following valve assemblies:

- a. Automatic shut-off valve shall be provided in the oil-supply line as close to the cylinder inlet as possible. When there is a 10 percent drop in NO-LOAD operating pressure, the automatic shut-off valve shall be activated. When activated, the device shall immediately stop the descent of elevator and hold the elevator until it is lowered by use of the maximum lowering feature of the valve. Manual lowering feature of automatic shut-off valve shall be arranged to limit the maximum descending speed of elevator to 0.08 m/s . Exposed adjustments of automatic shut-off shall have the means of adjustment sealed after being set to the correct position.
- b. Relief-valve for hydraulic shall be externally adjustable and shall bypass the total oil flow without increasing back pressure by more than 56 percent above working pressure.
- c. Safety check-valve shall close quietly without permitting any perceptible reverse flow and shall be designed to support the elevator on a positively locked column of oil when car is at rest.
- d. Up-start and stop valve shall be externally adjustable and shall bypass oil flow during the start-and-stop of motor-pump assembly. Valve shall close slowly, gradually diverting oil to the jack unit to insure smooth up-start and up-step.
- e. Lowering and leveling valve shall be externally adjustable for drop-away speed, lowering speed, leveling speed and stopping speed to insure smooth down-starts and stops. Leveling valve shall be designed to level the car to floor in the direction the car is traveling when slowdown is initiated.
- f. Manual lowering valve shall be capable of lowering the elevator car in event of power failure. Manual-lowering valve shall be arranged to limit the maximum descending speed under manual operation to 0.08 m/s.
- g. A service check-valve shall be installed in oil supply line between power unit and jack.

2.14.1.6 Storage Tank

Storage tank shall be single-wall construction of steel with a steel cover. Manufacturer's recommendation for the type of oil to be used shall be included in written instructions for the care, adjustment and maintenance of equipment.

2.14.1.7 Controller

Electric controller shall be of the microprocessor based logic type with battery backup provided with reduced voltage starting. Components required for proper elevator performance shall be neatly mounted and wired and completely enclosed in a cabinet with a mechanically-latched door. Control cabinet shall be designed for mounting on power unit, wall or floor stand. Electric control apparatus shall be completely isolated from oil reservoir. A feature shall be incorporated in electrical control circuit that will cause elevator car to descent automatically to the lowest terminal landing, if the system runs low on oil during ascending of the car. If power-operated doors are used, the car and hoistway doors shall automatically open when car reaches landing to allow passengers to exit. Parked car shall have doors in closed position and all control buttons shall be made inoperative.

2.14.2 Sound Reduction

Sound-insulating panels shall isolate airborne noise from motor pump assembly. Openings shall be provided to adequately ventilate the power unit motor. A minimum of two sound-insulating couplings shall be installed in oil line in machine room between pump and jack. Couplings shall be designed and manufactured to be blowout proof. Oil-hydraulic silencer shall be installed in oil line near power unit and shall contain pulsation absorbing material surrounded by a blowout-proof housing. Power unit assembly shall be mounted on vibration pads to isolate the unit from building structure.

2.15 LEVELING DEVICE

Elevators shall be equipped with a 2-way leveling device to automatically bring the car to floor landings. Car shall automatically re-level at each landing to correct the overtravel and undertravel, and maintain the level regardless of load on car. Electric stopping system shall be arranged so that the car will stop level with the floor before brake is set. Stopping accuracy shall not exceed a plus or minus 6 mm.

2.16 JACK UNIT

Jack unit shall be designed and constructed of sufficient size to lift the gross load to the height specified and shall be free from oil leakage. Brittle material such as grey cast iron shall not be used in jack construction. Jack unit shall consist of the following:

- a. Direct displacement plunger fabricated of heavy seamless steel tubing accurately turned and polished.
- b. Stop-ring welded or screwed to the plunger to positively prevent plunger from leaving the cylinder.
- c. Internal guide bearing.

- d. Packing or seal.
- e. Drip ring around cylinder top.
- f. Outer cylinder made of steel tubing.
- g. Air bleeder.
- h. Brackets welded to jack cylinder for supporting the elevator on pit channels.
- i. Scavenger pump with copper tubing connected to the tank.

2.17 ELEVATOR SUPPORTS

Structural steel beams, inserts, brackets, bolts and fastening devices shall be provided for proper installation of elevator equipment. Wood plugs are not acceptable.

2.18 BUFFERS

Buffers shall be of design suitable for depth of pit. Buffer anchorage at pit floors shall be provided for each car and counterweight and arranged to avoid puncturing the pit waterproofing. Type of buffer used shall be tested and approved for compliance with elevator service requirements before installation. Pipe struts and steadiers shall be provided as required for pit conditions. A metal plate with information concerning stroke and load-rating shall be permanently fastened to each buffer. Pit-mounted buffers shall have an adequate stroke designed to bring the fully-loaded car and counterweight to rest from governor tripping speed at an average rate of retardation not exceeding gravity. Moving portion of buffer shall be designed to be accelerated by the car without noticeable peak retardation. Spring buffers shall be in accordance with ASME A17.1A17.1.

2.19 LUBRICATION POINTS

Every part subject to movement friction shall be provided with provisions for oil or grease lubrication. All points of lubrication shall be readily accessible.

2.20 SEISMIC REQUIREMENTS

Seismic protection shall be provided in conformance with TI 809-04 for general guidance and computation of forces (1.0 G horizontal and 1.0 G vertical minimum), ASME A17.1, Rule XXIV, and IBC as shown on the drawings.

2.21 ELEVATOR PIT COMPONENTS

2.21.1 Ladder

Elevator pit shall be provided with galvanized steel access ladder conforming with SECTION: MISCELLANEOUS METAL. Top rung of ladder shall be readily accessible from first floor landing and have the same elevation as finished floor. Ladder location shall be coordinated with elevator car and operating equipment to eliminate any spatial conflicts.

2.21.2 Illumination

Pit shall be provided with impact resistant fluorescent light fixture capable of providing minimum average pit illumination of 215 lx (20 footcandles). Control switch for light fixture shall be inside the hoistway and easily accessible while standing at the first floor landing. Provide sign with 25 mm high letters indicating position of light switch.

2.22 ELEVATOR PIT SUMP

Pit sump shall be equipped with float switch activated automatic sump pump. Sump pump shall not discharge directly to sanitary or storm sewers. Activation of sump pump shall signal through HVAC DDC control system and illuminate a wall mounted signal light, location as indicated. Pump shall discharge to 20 gallon holding/inspection container located in elevator machine room. Holding/inspection container shall have a valve controlled drain to sanitary sewer.

PART 3 EXECUTION

3.1 INSTALLATION

Elevators and equipment shall be installed in accordance with ASME A17.1 and manufacturer's recommendation. Guide rails shall be set plumb and parallel and attached to guide rail brackets secured to building structure as indicated and at intervals not exceeding 4.4 m. Steel shim plates shall be used for aligning equipment. Guide rail sections shall be joined together in accordance with ASME A17.1. Guide rails shall be thoroughly cleaned and made smooth before elevator is put into operation. During installation all stainless steel shall be protected.

3.2 FIELD WELDING

When structural or load-bearing members are to be field welded, welding and qualification of welders shall be as specified in SECTION: WELDING, STRUCTURAL.

3.3 CASING, CYLINDER AND PLUNGER UNIT

A steel casing minimum 200 mm larger in diameter than the cylinder sealed at bottom with steel plate or concrete plug shall be complete with provisions to accommodate a single wall or double wall cylinder. Casing shall be accurately positioned, plumbed and set to accept the cylinder. The cylinder shall be protected from corrosion by totally enclosing the cylinder with a separate schedule 80, polyvinyl chloride jacket or with a high density, fused polyethylene coating, recommended by the manufacturer. Area between casing and cylinder wall shall be filled with washed dry sand after cylinder has been accurately located. Top of casing shall be sealed. The work of boring the well and setting the cylinder shall be coordinated with construction of concrete pit.

3.4 ELEVATOR WIRING

Wiring shall be provided for electrically-operated items of elevator equipment to comply with requirements of NFPA 70 and SECTION: ELECTRICAL WORK, INTERIOR. For control and signal circuits wire shall be minimum No. 18 AWG. For power and lighting circuits wire shall be minimum No. 12 AWG. Work light fixtures equipped with 150 watt incandescent lamps

and ground duplex receptacles shall be provided at top and bottom of car. Work light fixtures and traveling cable junction boxes shall be located to provide illumination at junction boxes. Wiring shall terminate in junction boxes. Wires shall be identified and shall match symbols shown on wiring diagrams. Control and signal wires shall be brought to accessible numbered terminal blocks on the controller. Intra-panel wiring shall be flame-resistant type.

3.4.1 Traveling Cables

Cables shall terminate at numbered terminal blocks in car and machine room. Traveling cable shall be provided with a separate shielded circuit for communication system and hang to obtain proper size of loop. Traveling cable shall be provided with 10 percent spare conductors for each car.

3.5 PAINTING AND PIPE COLOR CODE MARKING

Except for factory-finished items and corrosion-resistant items, machined surfaces shall be painted as specified in SECTION: PAINTING, GENERAL. Color Code marking of piping shall be as specified in SECTION: PAINTING, GENERAL.

3.6 ADJUSTMENTS

After installation is complete the Contractor shall adjust the equipment to achieve proper operation. Such testing and adjusting shall be in accordance with the applicable provisions of ASME A17.1. The cost of all regular adjustments and emergency service for a period of one year following acceptance shall be the responsibility of the Contractor.

3.6.1 Regular Adjustments

Regular adjustments of the installation by competent and trained elevator servicemen shall be performed during the regular working hours of regular working days and shall include adjustments to, greasing, oiling and cleaning of equipment and furnishing required supplies and parts. Regular adjustments shall be made every three months for a period of one year following acceptance by the Government.

3.6.2 Emergency Call Back Service

Should trouble develop between regular adjustments, the Contractor shall furnish special adjustments to correct the trouble. Emergency service shall be available 24 hours a day, 7 days per week. Response shall be provided within 24 hours of initial service call.

3.7 TESTING

Testing shall be in accordance with requirements of ASME A17.1 and ASME A17.2.2; and as specified below. The Contractor shall conduct a complete test of the system. After the system has passed all tests, the Contractor shall notify the Contracting Officer in writing, 10 days prior to the time of performing the acceptance test, that the system is complete and is ready for final acceptance testing. The Contractor after receiving written approval from the Contracting Officer will conduct a complete acceptance test of the system. The Contractor shall provide the services of an elevator inspector, employed by an independent testing company to inspect the elevators, witness the final testing and certify the elevators. The inspector shall meet all qualification requirements of ASME QEI-1 and shall be certified in

accordance with ASME QEI-1. The Contractor shall provide an elevator certificate signed by the inspector for each elevator. The certificate shall be provided to the Contracting Officer within 30 day after the completion of all testing.

3.7.1 Testing Period

Elevator shall be tested with the specified rated-load in car continuously for a period of 35 percent of the duty time. During the test run the car shall be stopped at all floors in both directions of travel for a standing period of 10 seconds per floor. A manual test of the final limits (UP and DOWN overtravel) shall also be performed.

3.7.2 Speed Load Testing

The actual speed of elevator car in both directions of travel shall be determined with the rated-load and with no-load in the elevator car. Actual measured speed of car with the rated-load in the UP direction shall be within 5percent of rated speed. The maximum difference in actual measured speeds obtained under the various conditions outlined shall not exceed 10 percent of the total difference between the UP and DOWN speeds.

3.7.3 Car Leveling Testing

Elevator car-leveling devices shall be tested for accuracy of landing at all floors with no-load in car, with symmetrical load in car and with the rated-load in car in both directions of travel.

3.7.4 Temperature Rise Testing

Temperature rise of hydraulic pump motor, motor drive, exciter and booster shall be conducted during the full-load test run for minimum one hour. Under these conditions, temperature rise of equipment shall not exceed the requirements established in NEMA MG 1 Chapter 12. Test shall be started when all parts of equipment are within the temperature required by NEMA at time of starting tests.

3.7.5 Insulation-Resistance Testing

Insulation-resistance testing shall be performed to ensure that the complete elevator wiring systems will be free from short circuits and grounds. Electrical conductors shall have an insulation-resistance of not less than 1 megohm between each conductor and ground, and not less than 1 megohm between each conductor and all other conductors. Prior to testing, provisions shall be made to prevent damage to electronic devices.

3.8 FRAMED INSTRUCTIONS

Two sets of instructions shall be typed and framed in laminated plastic, and posted side-by-side in the elevator room where directed before acceptance of elevator systems. First set of instructions shall include wiring and control diagrams showing the complete layout of elevator system. Second set of instructions shall include the condensed operating instructions describing preventive maintenance procedures, the methods for checking the elevator system for normal safe operation, and the procedures for safely starting and stopping the elevator system.

3.9 OPERATOR TRAINING

Contractor shall conduct a formal training course for operating Government personnel which shall include care, lubrication, adjustment and maintenance of elevator equipment. Training period shall consist of a total of 16 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. Field instructions shall cover all of the items contained in the operating and maintenance instructions, including demonstrations of routine maintenance operations. Contracting Officer shall be notified at least 14 days prior to date of starting the training course.

END OF SECTION

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SECTION 15070

SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ENGINEERING TECHNICAL INSTRUCTIONS

TI 809-04 (1998) Seismic Design for Buildings

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA Seismic Restraint Mnl. (1998) Seismic Restraint Manual Guidelines for Mechanical Systems

1.2 SYSTEM DESCRIPTION

1.2.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the mechanical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.2.2 Mechanical Equipment

Mechanical equipment to be seismically protected shall include the following items to the extent required on the drawings or in other sections of these specifications:

Boilers Storage Tanks for LPG and Water
Water Heaters Water, LPG and Gas Piping
Expansion Air Separator Tanks Valves and Fittings for Piping
Heat Exchangers
Air Compressors
Air Handling Units
Pumps with Motors Washing Machines

Gas Dryers Ducts
Unit Heaters
Exhaust and Return Fans

1.2.3 Mechanical Systems

The following mechanical systems shall be installed as required on the drawings or other sections of these specifications and shall be seismically protected in accordance with this specification:

All Piping Inside the Building Except as Specifically Stated Below Under "Items Not Covered By This Section".
Fuel Piping Outside of Buildings

All Water Supply Systems
Storm and Sanitary Sewer Systems
Outside of Buildings
Fuel Storage Tanks

1.2.4 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, the AISC LRFD Specifications shall be used for the design.

1.2.5 Items Not Covered By This Section

1.2.5.1 Fire Protection Systems

Seismic protection of piping for fire protection systems shall be installed as specified in Sections 13930A WET PIPE SPRINKLER SYSTEM, FIRE PROTECTION.

1.2.5.2 Items Requiring No Seismic Restraints

Seismic restraints are not required for the following items:

- a. Gas piping less than 25 mm (1 inch) inside diameter.
- b. Piping in boiler and mechanical equipment rooms less than 32 mm (1-1/4 inches) inside diameter.
- c. All other piping less than 64 mm (2-1/2 inches) inside diameter.
- d. Rectangular air handling ducts less than 0.56 square meters 6 square feet in cross sectional area.
- e. Round air handling ducts less than 711 mm (28 inches) in diameter.
- f. Piping suspended by individual hangers 300 mm (12 inches) or less in length from the top of pipe to the bottom of the supporting structural member where the hanger is attached, except as noted below.
- g. Ducts suspended by hangers 300 mm (12 inches) or less in length from the top of the duct to the bottom of the supporting structural member, except as noted below.

In exemptions f. and g. all hangers shall meet the length requirements. If the length requirement is exceeded by one hanger in the run, the entire run shall be braced. Interior piping and ducts not listed above shall be seismically protected in accordance with the provisions of this specification.

1.3 EQUIPMENT REQUIREMENTS

1.3.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, duct, electrical conduit, etc., which cross the expansion joint shall be provided with flexible

joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Boilers
Floor Mounted Air-Handling Units and Fans
Water Heaters
Hot Water Storage Tanks
Washers
Dryers

1.3.2 Nonrigid or Flexibly-Mounted Equipment

The following specific items of equipment to be furnished shall be constructed and assembled to resist a horizontal lateral force of 1.5 times the operating weight of the equipment at the vertical center of gravity of the equipment.

Air Handling Units which are not floor mounted

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Coupling and Bracing; G.
Flexible Couplings or Joints; G.
Equipment Requirements; G.
Contractor Designed Bracing; G.

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Coupling and Bracing; G.
Equipment Requirements; G.

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G.

Copies of the design calculations with the drawings. Calculations shall be approved, certified, stamped and signed by a registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

SD-07 Certificates

Flexible Ball Joints; G.

Flexible ball joints shall be certified to be suitable for the service intended by the manufacturer. Information verifying experience at not less than 3 locations of 2 years' satisfactory operation in a similar application shall be submitted.

PART 2 PRODUCTS

2.1 FLEXIBLE COUPLINGS

Flexible couplings shall have same pressure and temperature ratings as adjoining pipe.

2.2 FLEXIBLE BALL JOINTS

Flexible ball joints shall have cast or wrought steel casing and ball parts capable of 360-degree rotation with not less than 15-degree angular movement.

2.3 FLEXIBLE MECHANICAL JOINTS

- a. Mechanical couplings for steel or cast iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- b. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets.

2.4 MANUFACTURED BALL JOINTS

Manufactured ball joints shall be as recommended by the manufacturer for the intended use, and shall be approved by the Contracting Officer before installation.

2.5 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 COUPLING AND BRACING

Coupling installation shall conform to the details either shown on the drawings, or as specified. Provisions of this paragraph apply to all piping within a 1.5 m (5 foot) line around outside of building unless buried in the ground. Piping grouped for support on trapeze-type hangers shall be braced at the same intervals as determined by the smallest diameter pipe of the group. Bracing rigidly attached to pipe flanges, or similar, shall not be used where it would interfere with thermal expansion of piping.

3.2 BUILDING DRIFT

Joints capable of accommodating seismic displacements shall be provided for vertical piping between floors of the building, where pipes pass through a building seismic or expansion joint, or where rigidly supported pipes connect to equipment with vibration isolators. Horizontal piping across expansion

joints shall accommodate the resultant of the drifts of each building unit in each orthogonal direction. For threaded piping, swing joints made of the same piping material shall be provided. For piping with manufactured ball joints the seismic drift shall be 0.015 meters per meter (feet per foot) of height above the base where the seismic separation occurs; this drift value shall be used in place of the expansion given in the manufacturer's selection table.

3.3 FLEXIBLE COUPLINGS OR JOINTS

3.3.1 Building Piping

Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers for pipe larger than 90 mm (3-1/2 inches) in diameter. Flexible couplings or joints shall be braced laterally without interfering with the action of the flexible coupling or joint. Cast iron waste and vent piping need only comply with these provisions when caulked joints are used. Flexible bell and spigot pipe joints using rubber gaskets may be used at each branch adjacent to tees and elbows for underground waste piping inside of building to satisfy these requirements.

3.3.2 Underground Piping

Underground piping and 100 mm (4 inch) or larger conduit shall have flexible couplings installed where the piping enters the building. The couplings shall accommodate 76 mm (3 inches) of relative movement between the pipe and the building in any direction. Additional flexible couplings shall be provided where shown on the drawings.

3.4 PIPE SLEEVES

Pipe sleeves in interior non-fire rated walls shall be sized in conjunction with the contractor designed bracing to provide clearances that will permit differential movement of piping without the piping striking the pipe sleeve. Pipe sleeves in fire rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

3.5 SPREADERS

Spreaders shall be provided between adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 100 mm (4 inches) apart. Spreaders shall be applied at same interval as sway braces at an equal distance between the sway braces. If rack type hangers are used where the pipes are restrained from contact by mounting to the rack, spreaders are not required for pipes mounted in the rack. Spreaders shall be applied to surface of bare pipe and over insulation on insulated pipes utilizing high-density inserts and pipe protection shields in accordance with the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.6 SWAY BRACES FOR PIPING

Sway braces shall be provided to prevent movement of the pipes under seismic loading. Braces shall be provided in both the longitudinal and transverse directions, relative to the axis of the pipe. The bracing shall not interfere with thermal expansion requirements for the pipes as described in other sections of these specifications.

3.6.1 Transverse Sway Bracing

Transverse sway bracing for steel and copper pipe shall be provided as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT. Transverse sway bracing for pipes of materials other than steel and copper shall be provided at intervals not to exceed the hanger spacing as specified in Section 15400 PLUMBING, GENERAL PURPOSE.

3.6.2 Longitudinal Sway Bracing

Longitudinal sway bracing shall be provided at 12 m (40 foot) intervals unless otherwise indicated. All runs (length of pipe between end joints) shall have one longitudinal brace minimum. Sway braces shall be constructed in accordance with the drawings. Branch lines, walls, or floors shall not be used as sway braces.

3.6.3 Vertical Runs

Run is defined as length of pipe between end joints. Vertical runs of piping shall be braced at not more than 3 m (10 foot) vertical intervals. Braces for vertical runs shall be above the center of gravity of the segment being braced. All sway braces shall be constructed in accordance with the drawings. Sway branches shall not be connected to branch lines, walls, or floors.

3.6.4 Clamps and Hangers

Clamps or hangers on uninsulated pipes shall be applied directly to pipe. Insulated piping shall have clamps or hangers applied over insulation in accordance with Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.7 SWAY BRACES FOR DUCTS

3.7.1 Braced Ducts

Bracing details and spacing for rectangular and round ducts shall be in accordance with SMACNA Seismic Restraint Mnl., including Appendix E. However, the design seismic loadings for these items shall not be less than loadings obtained using the procedures in TI 809-04.

3.7.2 Unbraced Ducts

Hangers for unbraced ducts shall be attached to the duct within 50 mm (2 inches) of the top of the duct with a minimum of two #10 sheet metal screws and in accordance with SMACNA Seismic Restraint Mnl. Unbraced ducts shall be installed with a 150 mm (6 inch) minimum clearance to vertical ceiling hanger wires.

END OF SECTION

SECTION 15080

THERMAL INSULATION FOR MECHANICAL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only. At the discretion of the Government, the manufacturer of any material supplied will be required to furnish test reports pertaining to any of the tests necessary to assure compliance with the standard or standards referenced in this specification.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 580/A 580M	(1998) Stainless Steel Wire
ASTM B 209	(1996) Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B 209M	(2000) Aluminum and Aluminum-Alloy Sheet and Plate (Metric)
ASTM C 195	(1995) Mineral Fiber Thermal Insulating Cement
ASTM C 449/C 449M	(1995) Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
ASTM C 518	(1998) Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
ASTM C 533	(1995) Calcium Silicate Block and Pipe Thermal Insulation
ASTM C 534	(1999) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
ASTM C 547	(1995) Mineral Fiber Pipe Insulation
ASTM C 552	(2000) Cellular Glass Thermal Insulation
ASTM C 553	(1999) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
ASTM C 591	(1994) Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
ASTM C 610	(1999) Molded Expanded Perlite Block and Pipe Thermal Insulation
ASTM C 612	(2000) Mineral Fiber Block and Board Thermal Insulation

ASTM C 647	(1995) Properties and Tests of Mastics and Coating Finishes for Thermal Insulation
ASTM C 665	(1998) Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing
ASTM C 795	(1992; R 1998e1) Thermal Insulation for Use in Contact With Austenitic Stainless Steel
ASTM C 916	(1985; R 1996e1) Adhesives for Duct Thermal Insulation
ASTM C 920	(1998) Elastomeric Joint Sealants
ASTM C 921	(1989; R 1996) Determining the Properties of Jacketing Materials for Thermal Insulation
ASTM C 1126	(1998) Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
ASTM C 1136	(1995) Flexible, Low Permeance Vapor Retarders for Thermal Insulation
ASTM C 1290	(1995) Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts
ASTM E 84	(2000a) Surface Burning Characteristics of Building Materials
ASTM E 96	(2000) Water Vapor Transmission of Materials

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
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MIDWEST INSULATION CONTRACTORS ASSOCIATION (MICA)

MICA Insulation Stds	(1993) National Commercial & Industrial Insulation Standards
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1.2 SYSTEM DESCRIPTION

Field-applied insulation and accessories on mechanical systems shall be as specified herein; factory-applied insulation is specified under the piping, duct or equipment to be insulated. Field applied insulation materials required for use on Government-furnished items as listed in the SPECIAL CONTRACT REQUIREMENTS shall be furnished and installed by the Contractor.

1.3 GENERAL QUALITY CONTROL

1.3.1 Standard Products

Materials shall be the standard products of manufacturers regularly engaged in the manufacture of such products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.3.2 Installer's Qualifications

Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

1.3.3 Surface Burning Characteristics

Unless otherwise specified, insulation not covered with a jacket shall have a flame spread index no higher than 75 and a smoke developed index no higher than 150. Insulation systems which are located in air plenums, in ceiling spaces, and in attic spaces shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50. Insulation materials located exterior to the building perimeter are not required to be fire-rated. Flame spread and smoke developed indexes shall be determined by ASTM E 84. Insulation shall be tested in the same density and installed thickness as the material to be used in the actual construction. Material supplied by a manufacturer with a jacket shall be tested as a composite material. Jackets, facings, and adhesives shall have a flame spread index no higher than 25 and a smoke developed index no higher than 50 when tested in accordance with ASTM E 84.

1.3.4 Identification of Materials

Packages or standard containers of insulation, jacket material, cements, adhesives, and coatings delivered for use, and samples required for approval shall have manufacturer's stamp or label attached giving the name of the manufacturer and brand, and a description of the material.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-04 Samples

Thermal Insulation Materials; G

A complete list of materials, including manufacturer's descriptive technical literature, performance data, catalog cuts, and installation instructions. The product number, k-value, thickness and furnished accessories for each mechanical system requiring insulation shall be included. Materials furnished under this section of the specification shall be submitted at one time.

After approval of materials and prior to applying insulation a booklet shall be prepared and submitted for approval. The booklet shall contain marked-up MICA Insulation Stds plates (or detail drawings showing the insulation material and insulating system) for each piece of equipment required to be insulated per this specification. The MICA plates shall be marked up showing the materials to be installed in accordance with the requirements of this specification for the specific insulation application. The Contractor shall submit all MICA Plates required to show the entire insulating system, including Plates required to show insulation penetrations, vessel bottom and top heads, legs, and skirt insulation as applicable. If the Contractor elects to submit detailed drawings instead of marked-up MICA Plates, the detail drawings shall show cut-away, section views, and details indicating each component of the insulation system and showing provisions for insulating jacketing, and sealing portions of the equipment. For each type of insulation installation on the drawings, provide a label which identifies each component in the installation (i.e., the duct, insulation, adhesive, vapor retarder, jacketing, tape, mechanical fasteners, etc.) Indicate insulation by type and manufacturer. Three copies of the booklet shall be submitted at the jobsite to the

Contracting Officer. One copy of the approved booklet shall remain with the insulation Contractor's display sample and two copies shall be provided for Government use.

After approval of materials actual sections of installed systems properly insulated in accordance with the specification requirements shall be displayed. Such actual sections must remain accessible to inspection throughout the job and will be reviewed from time to time for controlling the quality of the work throughout the construction site. Each material used shall be identified, by indicating on an attached sheet the specification requirement for the material and the material by each manufacturer intended to meet the requirement. Display sample sections will be inspected at the jobsite by the Contracting Officer. Approved display sample sections shall remain on display at the jobsite during the construction period. Upon completion of construction, the display sample sections will be closed and sealed.

Pipe Insulation Display Sections: Display sample sections shall include as a minimum an elbow or tee, a valve, dielectric unions and flanges, a hanger with protection shield and insulation insert, or dowel as required, at support point, method of fastening and sealing insulation at longitudinal lap, circumferential lap, butt joints at fittings and on pipe runs, and terminating points for each type of pipe insulation used on the job, and for hot pipelines and cold pipelines, both interior and exterior, even when the same type of insulation is used for these services.

Duct Insulation Display Sections: Display sample sections for rigid and flexible duct insulation used on the job. A display section for duct insulation exposed to weather shall be protected by enclosing with a temporary covering.

1.5 STORAGE

Materials shall be delivered in the manufacturer's unopened containers. Materials delivered and placed in storage shall be provided with protection from weather, humidity, dirt, dust and other contaminants. Insulation material and supplies that become dirty, dusty, wet, or otherwise contaminated may be rejected by the Contracting Officer.

PART 2 PRODUCTS

2.1 GENERAL MATERIALS

Materials shall be compatible and shall not contribute to corrosion, soften, or otherwise attack surfaces to which applied in either the wet or dry state. Materials to be used on stainless steel surfaces shall meet ASTM C 795 requirements. Materials shall be asbestos free and conform to the following:

2.1.1 Adhesives

2.1.1.1 Acoustical Lining Insulation Adhesive

Adhesive shall be a nonflammable, fire-resistant adhesive conforming to ASTM C 916, Type I.

2.1.1.2 Mineral Fiber Insulation Cement

Cement shall be in accordance with ASTM C 195.

2.1.1.3 Lagging Adhesive

Lagging is the material used for thermal insulation, especially around a cylindrical object. This may include the insulation as well as the cloth/material covering the insulation. Lagging adhesives shall be nonflammable and fire-resistant and shall have a flame spread rating no higher than 25 and a smoke

developed rating no higher than 50 when tested in accordance with ASTM E 84. Adhesive shall be pigmented [white] [red] and be suitable for bonding fibrous glass cloth to faced and unfaced fibrous glass insulation board; for bonding cotton brattice cloth to faced and unfaced fibrous glass insulation board; for sealing edges of and bounding fibrous glass tape to joints of fibrous glass board; for bonding lagging cloth to thermal insulation; or for attaching fibrous glass insulation to metal surfaces. Lagging adhesives shall be applied in strict accordance with the manufacturer's recommendations.

2.1.2 Contact Adhesive

Adhesive may be dispersed in a nonhalogenated organic solvent or, dispersed in a nonflammable organic solvent which shall not have a fire point below 94 degrees C (200 degrees F). The adhesive shall not adversely affect, initially or in service, the insulation to which it is applied, nor shall it cause any corrosive effect on metal to which it is applied. Any solvent dispersing medium or volatile component of the adhesive shall have no objectionable odor and shall not contain any benzene or carbon tetrachloride. The dried adhesive shall not emit nauseous, irritating, or toxic volatile matters or aerosols when the adhesive is heated to any temperature up to 100 degrees C (212 degrees F). The adhesive shall be nonflammable and fire resistant.

2.1.3 Caulking

ASTM C 920, Type S, Grade NS, Class 25, Use A.

2.1.4 Corner Angles

Nominal 0.4060 mm (0.016 inch) thickness, aluminum, 25 x 25 mm (1 x 1 inch) with factory applied kraft backing. Aluminum shall be ASTM B 209M ASTM B 209, Alloy 3003, 3105, or 5005.

2.1.5 Finishing Cement

Mineral fiber hydraulic-setting thermal insulating cement ASTM C 449/C 449M. All cements that may come in contact with Austenitic stainless steel must include testing per ASTM C 795.

2.1.6 Fibrous Glass Cloth and Glass Tape

Fibrous glass cloth and glass tape shall have flame spread and smoke developed ratings of no greater than 25/50 when measured in accordance with ASTM E 84. Tape shall be 100 mm (4 inch wide) rolls.

2.1.7 Staples

Outward clinching type monel or ASTM A 167, Type 304 or 316 stainless steel.

2.1.8 Jackets

ASTM C 921, Type I, maximum moisture vapor transmission 0.02 perms, (measured before factory application or installation), minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where a minimum puncture resistance of 25 Beach units is acceptable. Minimum tensile strength, 6.1 N/mm (35 pounds/inch) width. ASTM C 921, Type II, minimum puncture resistance 25 Beach units, tensile strength minimum 3.5 N/mm (20 pounds /inch) width. Jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing. Based on the application, insulation materials which require factory applied jackets are mineral fiber, cellular glass, and phenolic foam. All non-metallic jackets shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E 84.

2.1.8.1 White Vapor Retarder All Service Jacket (ASJ)

For use on hot/cold pipes, ducts, or equipment. Vapor retarder jackets used on insulation exposed in finished areas shall have white finish suitable for painting without sizing.

2.1.8.2 Aluminum Jackets

Aluminum jackets shall be corrugated, embossed or smooth sheet, 0.4060 mm (0.016 inch) nominal thickness; ASTM B 209M ASTM B 209, Temper H14, Temper H16, Alloy 3003, 5005, or 3105 with factory applied moisture retarder. Corrugated aluminum jacket shall not be used outdoors. Aluminum jacket securing bands shall be Type 304 stainless steel, 0.3960 mm (0.015 inch) thick, 12.7 mm (1/2 inch) wide for pipe under 300 mm (12 inch) diameter and 19.1 mm (3/4 inch) wide for pipe over 300 mm (12 inch) and larger diameter. Aluminum jacket circumferential seam bands shall be 50.8 x 0.4060 mm (2 x 0.016) inch aluminum matching jacket material. Bands for insulation below ground shall be 19.1 x 0.5080 mm (3/4 x 0.020 inch) thick stainless steel, or fiberglass reinforced tape. The jacket may, at the option of the Contractor, be provided with a factory fabricated Pittsburgh or "Z" type longitudinal joint. When the "Z" joint is used, the bands at the circumferential joints shall be designed by the manufacturer to seal the joints and hold the jacket in place.

2.1.8.3 Polyvinyl Chloride (PVC) Jackets

Polyvinyl chloride (PVC) jacket and fitting covers shall have high impact strength, UV resistant rating or treatment and moderate chemical resistance with minimum thickness 0.7620 mm (0.030 inch).

2.1.9 Vapor Retarder Coating

The vapor retarder coating shall be fire and water resistant and appropriately selected for either outdoor or indoor service. Color shall be white. The water vapor permeance of the compound shall be determined according to procedure B of ASTM E 96 utilizing apparatus described in ASTM E 96. The coating shall be a nonflammable, fire resistant type. All other application and service properties shall be in accordance with ASTM C 647.

2.1.9.1 Vapor Retarder Required

ASTM C 1136, Type I, maximum moisture vapor transmission 0.02 perms, minimum puncture resistance 50 Beach units on all surfaces except concealed ductwork, where Type II, maximum moisture vapor transmission 0.02 perms, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.9.2 Vapor Retarder Not Required

ASTM C 1136, Type III, maximum moisture vapor transmission 0.10 perms, minimum puncture resistance 50 Beach units on all surfaces except ductwork, where Type IV, maximum moisture vapor transmission 0.10, a minimum puncture resistance of 25 Beach units is acceptable.

2.1.10 Wire

Soft annealed ASTM A 580/A 580M Type 302, 304 or 316 stainless steel, 16 or 18 gauge.

2.2 PIPE INSULATION MATERIALS

Insulation materials shall conform to EPA requirements in accordance with Section 01670 RECYCLED / RECOVERED MATERIALS. Pipe insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.2.1 Aboveground Cold Pipeline

Insulation for minus 34 degrees to plus 16 degrees C (minus 30 degrees to plus 60 degrees F) for outdoor, indoor, exposed or concealed applications, shall be as follows:

- a. Cellular Glass: ASTM C 552, Type II, and Type III. Supply the insulation with manufacturer's recommended factory applied jacket.
- b. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II. Type II shall have vapor retarder skin on both sides of the insulation.
- c. Phenolic Insulation: ASTM C 1126, Type III. Phenolic insulations shall comply with ASTM C 795 and with the ASTM C 665 paragraph Corrosiveness. Supply the insulation with manufacturer's recommended factory applied jacket.
- d. Mineral Fiber: ASTM C 547
- e. Polyisocyanurate Insulation: ASTM C 591, type I. Supply the insulation with manufacturer's recommended factory applied jacket.

2.2.2 Aboveground Hot Pipeline

Insulation for above 16 degrees C (60 degrees F), for outdoor, indoor, exposed or concealed applications shall meet the following requirements. Supply the insulation with manufacturers recommended factory applied jacket.

- a. Mineral Fiber: ASTM C 547, Types I, II or III, supply the insulation with manufacturers recommended factory applied jacket.
- b. Calcium Silicate: ASTM C 533, Type I indoor only, or outdoors above 121 degrees C (250 degrees F) pipe temperature.
- c. Cellular Glass: ASTM C 552, Type II and Type III. Supply the insulation with manufacturers recommended factory applied jacket.
- d. Flexible Elastomeric Cellular Insulation: ASTM C 534, Type I or II to 93 degrees C (200 degrees F) service.
- e. Phenolic Insulation: ASTM C 1126 Type III to 121 C (250 F) service shall comply with ASTM C 795. Supply the insulation with manufacturers recommended factory applied jacket.
- f. Perlite Insulation: ASTM C 610
- g. Polyisocyanurate Insulation: ASTM C 591, Type 1, to 149 degrees C (300 degrees F) service. Supply the insulation with manufacturer's recommended factory applied jacket.

2.3 DUCT INSULATION MATERIALS

Duct insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.3.1 Rigid Mineral Fiber

ASTM C 612, Type IA, IB, II, III, & IV.

2.3.2 Flexible Mineral Fiber

ASTM C 553, Type I, or Type II up to 121 C (250 F). ASTM C 1290 Type III.

2.3.3 Cellular Glass

ASTM C 552, Type I.

2.3.4 Phenolic Foam

ASTM C 1126 Type II, shall comply with ASTM C 795.

2.3.5 Flexible Elastomeric Cellular

ASTM C 534 Type II.

2.3.6 Polyisocyanurate

ASTM C 591, Type 1. Supply the insulation with manufacturer's recommended factory applied jacket.

2.4 EQUIPMENT INSULATION MATERIALS

Equipment insulation materials shall be limited to those listed herein and shall meet the following requirements:

2.4.1 Cold Equipment Insulation

For temperatures below 16 degrees C (60 degrees F).

2.4.1.1 Cellular Glass

ASTM C 552, Type I, Type III, or Type IV as required.

2.4.1.2 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II.

2.4.1.3 Phenolic Foam

ASTM C 1126 Type II shall comply with ASTM C 795.

2.4.1.4 Polyisocyanurate Foam

ASTM C 591, Type I. Supply the insulation with manufacturer's factory applied jacket.

2.4.2 Hot Equipment Insulation

For temperatures above 16 degrees C (60 degrees F).

2.4.2.1 Rigid Mineral Fiber

ASTM C 612, Type IA, IB, II, III, IV, or V as required for temperature encountered to 982 degrees C (1800 degrees F).

2.4.2.2 Flexible Mineral Fiber

ASTM C 553, Type I, II, III, IV, V, VI or VII as required for temperature encountered to 649 degrees C (1200 degrees F).

2.4.2.3 Calcium Silicate

ASTM C 533, Type I, indoors only, or outdoors above 121 degrees C. 250 degrees F. Pipe shape may be used on diesel engine exhaust piping and mufflers to 649 degrees C (1200 degrees F).

2.4.2.4 Cellular Glass

ASTM C 552, Type I, Type III, or Type IV as required.

2.4.2.5 Flexible Elastomeric Cellular Insulation

ASTM C 534, Type II, to 93 degrees C (200 degrees F).

2.4.2.6 Phenolic Foam

ASTM C 1126 Type II to 121 degrees C (250 degrees F) shall comply with ASTM C 795.

2.4.2.7 Molded Expanded Perlite

ASTM C 610.

2.4.2.8 Polyisocyanurate Foam:

ASTM C 591, Type I. Supply the insulation with manufacturer's recommended factory applied jacket.

PART 3 EXECUTION

3.1 APPLICATION - GENERAL

Insulation shall only be applied to unheated and uncooled piping and equipment. Flexible elastomeric cellular insulation shall not be compressed at joists, studs, columns, ducts, hangers, etc. The insulation shall not pull apart after one hour period; any insulation found to pull apart after one hour shall be replaced.

3.1.1 Installation

Except as otherwise specified, material shall be installed in accordance with the manufacturer's written instructions. Insulation materials shall not be applied until [tests] [tests and heat tracing] specified in other sections of this specification are completed. Material such as rust, scale, dirt and moisture shall be removed from surfaces to receive insulation. Insulation shall be kept clean and dry. Insulation shall not be removed from its shipping containers until the day it is ready to use and shall be returned to like containers or equally protected from dirt and moisture at the end of each workday. Insulation that becomes dirty shall be thoroughly cleaned prior to use. If insulation becomes wet or if cleaning does not restore the surfaces to like new condition, the insulation will be rejected, and shall be immediately removed from the jobsite. Joints shall be staggered on multi layer insulation. Mineral fiber thermal insulating cement shall be mixed with demineralized water when used on stainless steel surfaces. Insulation, jacketing and accessories shall be installed in accordance with MICA Insulation Std's standard plates except where modified herein or on the drawings.

3.1.2 Firestopping

Where pipes and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in Section 07840 FIRESTOPPING.

3.1.3 Painting and Finishing

Painting shall be as specified in Section 09900 PAINTING, GENERAL.

3.1.4 Installation of Flexible Elastomeric Cellular Insulation

Flexible elastomeric cellular insulation shall be installed with seams and joints sealed with rubberized contact adhesive. Insulation with pre-applied adhesive is not permitted. Flexible elastomeric cellular insulation shall not be used on surfaces greater than 93 degrees C (200 degrees F). Seams shall be staggered when applying multiple layers of insulation. Insulation exposed to weather and not shown to have jacketing shall be protected with two coats of UV resistant finish as recommended by the manufacturer after the adhesive is dry. A brush coating of adhesive shall be applied to both butt ends to be joined and to both slit surfaces to be sealed. The adhesive shall be allowed to set until dry to touch but tacky under slight pressure before joining the surfaces. Insulation seals at seams and joints shall not be capable of being pulled apart one hour after application. Insulation that can be pulled apart one hour after installation shall be replaced.

3.1.5 Welding

No welding shall be done on piping, duct or equipment without written approval of the Contracting Officer. The capacitor discharge welding process may be used for securing metal fasteners to duct</TAI>.

3.1.6 Pipes/Ducts/Equipment which Require Insulation

Insulation is required on all pipes, ducts, or equipment, except for omitted items, as specified.

3.2 PIPE INSULATION INSTALLATION

3.2.1 Pipe Insulation

3.2.1.1 General

Pipe insulation shall be installed on aboveground hot and cold pipeline systems as specified below to form a continuous thermal retarder, including straight runs, fittings and appurtenances unless specified otherwise. Installation shall be with full length units of insulation and using a single cut piece to complete a run. Cut pieces or scraps abutting each other shall not be used. Pipe insulation shall be omitted on the following:

- a. Pipe used solely for fire protection.
- b. Chromium plated pipe to plumbing fixtures. However, fixtures for use by the physically handicapped shall have the hot water supply and drain, including the trap, insulated where exposed.
- c. Sanitary drain lines.
- d. Air chambers.

3.2.1.2 Pipes Passing Through Walls, Roofs, and Floors

- a. Pipe insulation shall be continuous through the sleeve.
- b. An aluminum jacket with factory applied moisture retarder shall be provided over the insulation wherever penetrations require sealing.
- c. Where penetrating interior walls, the aluminum jacket shall extend 50 mm 2 inches beyond either side of the wall and shall be secured on each end with a band.
- d. Where penetrating floors, the aluminum jacket shall extend from a point below the backup material to a point 250 mm 10 inches above the floor with one band at the floor and one not more than 25 mm 1 inch from the end of the aluminum jacket.
- e. Where penetrating waterproofed floors, the aluminum jacket shall extend from below the backup material to a point 50 mm (2 inches) above the flashing with a band 25 mm (1 inch) from the end of the aluminum jacket.
- f. Where penetrating exterior walls, the aluminum jacket required for pipe exposed to weather shall continue through the sleeve to a point 50 mm (2 inches) beyond the interior surface of the wall.
- g. Where penetrating roofs, pipe shall be insulated as required for interior service to a point flush with the top of the flashing and sealed with vapor retarder coating. The insulation for exterior application shall butt tightly to the top of flashing and interior insulation. The exterior aluminum jacket shall extend 50 mm (2 inches) down beyond the end of the insulation to form a counter flashing. The flashing and counter flashing shall be sealed underneath with caulking.
- h. For hot water pipes supplying lavatories or other similar heated service which requires insulation, the insulation shall be terminated on the backside of the finished wall. The insulation termination shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm (1/16 inch) applied with glass tape embedded between coats (if applicable). The coating shall extend out onto the insulation 50.0 mm (2 inches) and shall seal the end of the insulation. Glass tape seams shall overlap 25 mm (1 inch). Caulk the annular space between the pipe and wall penetration with approved fire stop material. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration at least 10 mm (3/8 inch).
- i. For domestic cold water pipes supplying lavatories or other similar cooling service which requires insulation, the insulation shall be terminated on the finished side of the wall (i.e., insulation must cover the pipe throughout the wall penetration). The insulation shall be protected with two coats of vapor barrier coating with a minimum total thickness of 2.0 mm (1/16 inch). The coating shall extend out onto the insulation 50.0 mm (2 inches) and shall seal the end of the insulation. Caulk the annular space between the outer surface of the pipe insulation and the wall penetration with an approved fire stop material having vapor retarder properties. Cover the pipe and wall penetration with a properly sized (well fitting) escutcheon plate. The escutcheon plate shall overlap the wall penetration by at least 10 mm (3/8 inch).

3.2.1.3 Pipes Passing Through Hangers

- a. Insulation, whether hot or cold application, shall be continuous through hangers. All horizontal pipes 50 mm (2 inches) and smaller shall be supported on hangers with the addition of a Type 40 protection shield to protect the insulation in accordance with MSS SP-69. Whenever insulation shows signs of being compressed, or when the insulation or jacket

shows visible signs of distortion at or near the support shield, insulation inserts as specified below for piping larger than 50 mm (2 inches) shall be installed.

- b. Horizontal pipes larger than 50 mm 2 inches at 16 degrees C 60 degrees F and above shall be supported on hangers in accordance with MSS SP-69, and Section 15400 PLUMBING, GENERAL PURPOSE.
- c. Horizontal pipes larger than 50 mm (2 inches) and below 16 degrees C (60 degrees F) shall be supported on hangers with the addition of a Type 40 protection shield in accordance with MSS SP-69. An insulation insert of cellular glass or calcium silicate or perlite above 27 C (80 F) shall be installed above each shield. The insert shall cover not less than the bottom 180 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm (2 inches) on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm (1 inch), wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the weight of the pipe from crushing the insulation, as an option to installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert.
- d. Vertical pipes shall be supported with either Type 8 or Type 42 riser clamps with the addition of two Type 40 protection shields in accordance with MSS SP-69 covering the 360 degree arc of the insulation. An insulation insert of cellular glass or calcium silicate shall be installed between each shield and the pipe. The insert shall cover the 360 degree arc of the pipe. Inserts shall be the same thickness as the insulation, and shall extend 50 mm (2 inches) on each end beyond the protection shield. When insulation inserts are required per the above, and the insulation thickness is less than 25 mm (1 inch), wooden or cork dowels or blocks may be installed between the pipe and the shield to prevent the hanger from crushing the insulation, as an option instead of installing insulation inserts. The insulation jacket shall be continuous over the wooden dowel, wooden block, or insulation insert. The vertical weight of the pipe shall be supported with hangers located in a horizontal section of the pipe. When the pipe riser is longer than 9 m (30 feet) the weight of the pipe shall be additionally supported with hangers in the vertical run of the pipe which are directly clamped to the pipe, penetrating the pipe insulation. These hangers shall be insulated and the insulation jacket sealed as indicated herein for anchors in a similar service.
- e. Inserts shall be covered with a jacket material of the same appearance and quality as the adjoining pipe insulation jacket, shall overlap the adjoining pipe jacket 38 mm (1-1/2 inches) and shall be sealed as required for the pipe jacket. The jacket material used to cover inserts in flexible elastomeric cellular insulation shall conform to ASTM C 1136, Type 1, and is allowed to be of a different material than the adjoining insulation material.

3.2.1.4 Flexible Elastomeric Cellular Pipe Insulation

Flexible elastomeric cellular pipe insulation shall be tubular form for pipe sizes 150 mm (6 inches) and less. Type II sheet insulation used on pipes larger than 150 mm (6 inches) shall not be stretched around the pipe. On pipes larger than 300 mm (12 inches) adhere insulation directly to the pipe on the lower 1/3 of the pipe. Seams shall be staggered when applying multiple layers of insulation. Sweat fittings shall be insulated with miter-cut pieces the same size as on adjacent piping. Screwed fittings shall be insulated with sleeved fitting covers fabricated from miter-cut pieces and shall be overlapped and sealed to the adjacent pipe insulation.

3.2.1.5 Pipes in high abuse areas.

In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, welded PVC, stainless steel, or aluminum jackets shall be utilized. Pipe insulation to the 1.8 m (6 foot) level shall be protected.

3.2.2 Aboveground Cold Pipelines

The following cold pipelines shall be insulated per Table I minus 34 degrees C to plus 16 degrees C (minus 30 degrees to plus 60 degrees F):

- a. Domestic cold water.
- b. Make-up water.
- c. Horizontal and vertical portions of interior roof drains.

3.2.2.1 Insulation Thickness

Insulation thickness for cold pipelines shall be determined using Table I.

Table I - Cold Piping Insulation Thickness
Pipe Size (mm)

Type of Service	Material	Runouts up to 50 mm*	25 mm & less	30 50 mm	65 - 100 mm	125 - 150 mm	205 mm & larger
Cold domestic water, above and below ceilings, & make up water	CG	40	40	40	40	40	40
	FC	10	10	10	10	10	10
	PF	25	25	25	25	25	25
	PC	25	25	25	25	25	25
Horizontal & vertical roof drain leaders (including underside of roof drain fitting)	FC		15	15	15	15	15
	PF		25	25	25	25	25
	CG		40	40	40	40	40
	PC		25	25	25	25	25

*When runouts to terminal units exceed 3.66 m the entire length of runout shall be insulated like the main feed pipe.

Table I - Cold Piping Insulation Thickness
Pipe Size (inches)

Type of Service	Material	Runouts up to 2 in*	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Cold domestic water, above and below ceilings & makeup water	CG	1.5	1.5	1.5	1.5	1.5	1.5
	FC	3/8	3/8	3/8	3/8	3/8	3/8
	PF	1.0	1.0	1.0	1.0	1.0	1.0
	PC	1.0	1.0	1.0	1.0	1.0	1.0

Horizontal	FC	0.5	0.5	0.5	0.5	0.5
& vertical	PF	1.0	1.0	1.0	1.0	1.0
roof drain	CG	1.5	1.5	1.5	1.5	1.5
leaders	PC	1.0	1.0	1.0	1.0	1.0
(including underside of roof drain fitting)						

*When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like main feed pipe.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PC - Polyisocyanurate Foam

3.2.2.2 Jacket for Mineral Fiber, Cellular Glass, Phenolic Foam, and Polyisocyanurate Foam Insulated Pipe

Insulation shall be covered with a factory applied vapor retarder jacket or field applied seal welded PVC jacket. Insulation inside the building shown to be protected with an aluminum jacket shall have the insulation and vapor retarder jacket installed as specified herein. The aluminum jacket shall be installed as specified for piping exposed to weather, except sealing of the laps of the aluminum jacket is not required. In high abuse areas such as janitor closets and traffic areas in equipment rooms, kitchens, and mechanical rooms, aluminum jackets shall be utilized. Pipe insulation to the 1.8 m (6 ft) level will be protected.

3.2.2.3 Insulation for Straight Runs (Mineral Fiber, Cellular Glass, Phenolic Foam and Polyisocyanurate Foam)

- Insulation shall be applied to the pipe with joints tightly butted. All butted joints and ends shall be sealed with a vapor retarder coating.
- Longitudinal laps of the jacket material shall overlap not less than 38 mm (1-1/2 inches). Butt strips 75 mm (3 inches) wide shall be provided for circumferential joints.
- Laps and butt strips shall be secured with adhesive and stapled on 100 mm 4 inch centers if not factory self-sealing. If staples are used, they shall be sealed per paragraph 3.2.2.3 e.
- Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 50 degrees C (40 degrees and 120 degrees F) during installation. The lap system shall be installed in accordance with manufacturer's recommendations. Stapler shall be used only if specifically recommended by the manufacturer. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- All Staples, including those used to repair factory self-seal lap systems, shall be coated with a vapor retarder coating. All seams, except those on factory self-seal systems shall be coated with vapor retarder coating.

- f. Breaks and punctures in the jacket material shall be patched by wrapping a strip of jacket material around the pipe and securing it with adhesive, stapling, and coating with vapor retarder coating. The patch shall extend not less than 38 mm (1-1/2 inches) past the break.
- g. At penetrations such as thermometers, the voids in the insulation shall be filled and sealed with vapor retarder coating.

3.2.2.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories. The butted joints and ends shall be coated with vapor retarder coating.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates except as modified herein: 5 for anchors; 10, 11, and 13 for fittings; 14 for valves; and 17 for flanges and unions. Insulation shall be the same insulation as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm (2 inches) or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".
- c. Upon completion of insulation installation on flanges, unions, valves, anchors, fittings and accessories, terminations, seams, joints and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of vapor retarder coating with a minimum total thickness of 2.0 mm, 1/16 inch, applied with glass tape embedded between coats. Tape seams shall overlap 25 mm (1 inch). The coating shall extend out onto the adjoining pipe insulation 50 mm (2 inches). Fabricated insulation with a factory vapor retarder jacket shall be protected with two coats of vapor retarder coating with a minimum thickness of 2 mm (1/16 inch) and with a 50 mm (2 inch) wide glass tape embedded between coats. Where fitting insulation butts to pipe insulation, the joints shall be sealed with a vapor retarder coating and a 100 mm (4 inch) wide ASJ tape which matches the jacket of the pipe insulation.
- d. Anchors attached directly to the pipe shall be insulated for a sufficient distance to prevent condensation but not less than 150 mm (6 inches) from the insulation surface.
- e. Insulation shall be marked showing the location of unions, strainers, and check valves.

3.2.2.5 Optional PVC Fitting Covers

At the option of the Contractor, premolded, one or two piece PVC fitting covers may be used in lieu of the vapor retarder and embedded glass tape. Factory precut or premolded insulation segments shall be used under the fitting covers for elbows. Insulation segments shall be the same insulation as the pipe insulation including same density, thickness, and thermal conductivity. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers. Seams in the cover, and tacks and laps to adjoining pipe insulation jacket, shall be sealed with vapor retarder tape to ensure that the assembly has a continuous vapor seal.

3.2.3 Aboveground Hot Pipelines

The following hot pipelines above 16 degrees C (60 degrees F) shall be insulated per Table II:

- a. Domestic hot water supply & recirculating system.
- b. Hot water heating.

3.2.3.1 Insulation Thickness

Insulation thickness for hot pipelines shall be determined using Table II.

LEGEND:

PF - Phenolic Foam
CG - Cellular Glass
CS - Calcium Silicate
MF - Mineral Fiber
FC - Flexible Elastomeric Cellular
PL - Perlite
PC - Polyisocyanurate Foam

Table II - Hot Piping Insulation Thickness
Pipe Size (mm)

Type of Service (degrees C)	Material	Runouts up to 50 mm*	25 mm & less	32 - 50 mm	65 - 100 mm	125 - 150 mm	205 mm & larger
[Hot domestic water supply & recirculating system & Water defrost lines (93C max)**]	CG	40	40	40	40	40	40
	FC	15	25	25	40	40	40
	PF	15	25	25	25	25	25
	MF	15	40	40	40	40	40
	PC	25	25	25	25	25	25
Heating hot water, supply & return, & heated oil (121 C Max)	CG	40	40	50	50	65	80
	PF	15	25	25	25	25	40
	MF	15	40	40	50	65	80
	CS/PL	25	40	50	65	65	80
	PC	25	25	25	25	25	25]

* When runouts to terminal units exceed 3.66 m, the entire length of runout shall be insulated like the main feed pipe.

** Applied to recirculating sections of service or domestic hot water systems and first 2.4 meters from storage tank for non-recirculating systems.

Table II - Hot Piping Insulation Thickness
Pipe Size (inches)

Type of Service (degrees F)	Material	Runouts up to 2 in *	1 in & less	1.25 - 2 in	2.5 - 4 in	5 - 6 in	8 in & larger
Hot domestic	CG	1.5	1.5	1.5	1.5	1.5	1.5
water supply &	FC	0.5	0.5	1.0	1.0	1.5	1.5
recirculating	PF	0.5	0.5	1.0	1.0	1.0	1.0
system, & water	MF	0.5	1.5	1.5	1.5	1.5	1.5
defrost lines (200 F max)**	PC	1.0	1.0	1.0	1.0	1.0	1.0
Heating hot	CG	1.5	1.5	2.0	2.0	2.5	3.0
water, supply	PF	0.5	1.0	1.0	1.0	1.0	1.5
& return, &	MF	0.5	1.5	1.5	2.0	2.5	3.0
Heating oil	CS	1.0	1.5	2.0	2.5	2.5	3.0
(250 F max)	PC	1.0	1.0	1.0	1.0	1.0	1.0]

* When runouts to terminal units exceed 12 feet, the entire length of runout shall be insulated like the main feed pipe.

** Applies to recirculating sections of service or domestic hot water systems and first 8 feet from storage tank for non-recirculating systems.

3.2.3.2 Jacket for Insulated Hot Pipe, Except Pipe Insulated with Flexible Elastomeric Cellular

Insulation shall be covered, in accordance with manufacturer's recommendations, with a factory applied Type II jacket or field applied aluminum where required or seal welded PVC.

3.2.3.3 Insulation for Straight Runs

- Insulation shall be applied to the pipe with joints tightly butted.
- Longitudinal laps of the jacket material shall overlap not less than 38 mm (1-1/2 inches), and butt strips 75 mm (3 inches) wide shall be provided for circumferential joints.
- Laps and butt strips shall be secured with adhesive and stapled on 100 mm (4 inch) centers if not factory self-sealing. Adhesive may be omitted where pipe is concealed.
- Factory self-sealing lap systems may be used when the ambient temperature is between 4 degrees and 49 degrees C (40 degrees and 120 degrees F) and shall be installed in accordance with manufacturer's instructions. Laps and butt strips shall be stapled whenever there is nonadhesion of the system. Where gaps occur, the section shall be replaced or the gap repaired by applying adhesive under the lap and then stapling.
- Breaks and punctures in the jacket material shall be patched by either wrapping a strip of jacket material around the pipe and securing with adhesive and staple on 100 mm (4 inch) centers (if not factory self-sealing), or patching with tape and sealing with a brush coat of vapor retarder coating. Adhesive may be omitted where pipe is concealed. Patch shall extend not less than 38 mm (1-1/2 inches) past the break.
- Flexible elastomeric cellular pipe insulation shall be installed by slitting tubular sections and applying onto piping or tubing. Alternately, whenever possible, slide unslit sections over the

open ends of piping or tubing. All seams and butt joints shall be secured and sealed with adhesive. When using self seal products only the butt joints shall be secured with adhesive. Insulation shall be pushed on the pipe, never pulled. Stretching of insulation may result in open seams and joints. All edges shall be clean cut. Rough or jagged edges of the insulation shall not be permitted. Proper tools such as sharp knives shall be used. Type II sheet insulation when used on pipe larger than 150 mm (6 inches) shall not be stretched around the pipe. On pipes larger than 300 mm (12 inches), adhere sheet insulation directly to the pipe on the lower 1/3 of the pipe.

3.2.3.4 Insulation for Fittings and Accessories

- a. Pipe insulation shall be tightly butted to the insulation of the fittings and accessories.
- b. Precut or preformed insulation shall be placed around all fittings and accessories and shall conform to MICA plates, except as modified herein: 5 for anchors; 10, 11, 12, and 13 for fittings; 14, 15 and 16 for valves; 17 for flanges and unions; and 18 for couplings. Insulation shall be the same as the pipe insulation, including same density, thickness, and thermal conductivity. Where precut/preformed is unavailable, rigid preformed pipe insulation sections may be segmented into the shape required. Insulation of the same thickness and conductivity as the adjoining pipe insulation shall be used. If nesting size insulation is used, the insulation shall be overlapped 50 mm (2 inches) or one pipe diameter. Elbows insulated using segments shall conform to MICA Tables 12.20 "Mitered Insulation Elbow".
- c. Upon completion of installation of insulation on flanges, unions, valves, anchors, fittings and accessories, terminations and insulation not protected by factory vapor retarder jackets or PVC fitting covers shall be protected with two coats of adhesive applied with glass tape embedded between coats. Tape seams shall overlap 25 mm (1 inch). Adhesive shall extend onto the adjoining insulation not less than 50 mm (2 inches). The total dry film thickness shall be not less than 2.0 mm (1/16 inch).
- d. Insulation terminations shall be tapered to unions at a 45-degree angle.
- e. At the option of the Contractor, factory premolded one- or two-piece PVC fitting covers may be used in lieu of the adhesive and embedded glass tape. Factory premolded segments or factory or field cut blanket insert insulation segments shall be used under the cover and shall be the same thickness as adjoining pipe insulation. The covers shall be secured by PVC vapor retarder tape, adhesive, seal-welding or with tacks made for securing PVC covers.

3.2.4 Piping Exposed to Weather

Piping exposed to weather shall be insulated and jacketed as specified for the applicable service inside the building. After this procedure, an aluminum jacket or PVC jacket shall be applied. PVC jacketing requires no factory applied jacket beneath it, however an all service jacket shall be applied if factory applied jacketing is not furnished. Flexible elastomeric cellular insulation exposed to weather shall be treated in accordance with paragraph INSTALLATION OF FLEXIBLE ELASTOMERIC CELLULAR INSULATION.

3.2.4.1 Aluminum Jacket

The jacket for hot piping may be factory applied. The jacket shall overlap not less than 50 mm (2 inches) at longitudinal and circumferential joints and shall be secured with bands at not more than 300 mm (12 inch) centers. Longitudinal joints shall be overlapped down to shed water and located at 4 or 8 o'clock positions. Joints on piping 16 degrees C (60 degrees F) and below shall be sealed with caulking while overlapping to prevent moisture penetration. Where jacketing on piping 16 degrees C (60 degrees F) and below abuts an uninsulated surface, joints shall be caulked to prevent moisture

penetration. Joints on piping above 16 degrees C (60 degrees F) shall be sealed with a moisture retarder.

3.2.4.2 Insulation for Fittings

Flanges, unions, valves, fittings, and accessories shall be insulated and finished as specified for the applicable service. Two coats of breather emulsion type weatherproof mastic (impermeable to water, permeable to air) recommended by the insulation manufacturer shall be applied with glass tape embedded between coats. Tape overlaps shall be not less than 25 mm (1 inch) and the adjoining aluminum jacket not less than 50 mm (2 inches). Factory preformed aluminum jackets may be used in lieu of the above. Molded PVC fitting covers shall be provided when PVC jackets are used for straight runs of pipe. PVC fitting covers shall have adhesive welded joints and shall be weatherproof.

3.2.4.3 PVC Jacket

PVC jacket shall be ultraviolet resistant and adhesive welded weather tight with manufacturer's recommended adhesive. Installation shall include provision for thermal expansion.

3.3 DUCT INSULATION INSTALLATION

Corner angles shall be installed on external corners of insulation on ductwork in exposed finished spaces before covering with jacket. Duct insulation shall be omitted on exposed supply and return ducts in conditioned spaces where the difference between supply air temperature and room air temperature is less than 9 degrees C (15 degrees F) unless otherwise shown. Insulation for ducts in attic spaces which are not sprinklered shall be of non-combustible construction.

3.3.1 Duct Insulation Thickness

Duct insulation thickness shall be in accordance with Table III.

Table III - Minimum Duct Insulation (mm)

Cold Air Ducts	50
Relief Ducts	40
Fresh Air Intake Ducts	40
Warm Air Ducts	50
Relief Ducts	40
Fresh Air Intake Ducts	40

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 25 mm, and maximum thickness for polyisocyanurate foam insulation shall not exceed 40 mm to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50

Table III - Minimum Duct Insulation (inches)

Cold Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5
Warm Air Ducts	2.0
Relief Ducts	1.5
Fresh Air Intake Ducts	1.5

Maximum thickness for flexible elastomeric cellular insulation shall not exceed 1 inch and maximum thickness for polyisocyanurate foam insulation shall not exceed 1.5 inch, to comply with ASTM E 84 flame spread/smoke developed ratings of 25/50.

3.3.2 Insulation and Vapor Retarder for Cold Air Duct

Insulation and vapor retarder shall be provided for the following cold air ducts and associated equipment.

- a. Outside Air Supply ducts.
- b. Combustion air intake ducts.

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 12 kg per cubic meter (3/4 pcf) and rigid type where exposed, minimum density 48 kg per cubic meter (3 pcf). Insulation for round/oval ducts shall be flexible type, minimum density 12 kg per cubic meter (3/4 pcf) with a factory Type I or II jacket; or, a semi rigid board, minimum density 48 kg per cubic meter (3 pcf), formed or fabricated to a tight fit, edges beveled and joints tightly butted and staggered, with a factory applied Type I or II all service jacket. Insulation for exposed ducts shall be provided with either a white, paintable, factory-applied Type I jacket or a vapor retarder jacket coating finish as specified. Insulation on concealed duct shall be provided with a factory-applied Type I or II vapor retarder jacket. The total dry film thickness shall be approximately 2.0 mm (1/16 inch). Duct insulation shall be continuous through sleeves and prepared openings except fire wall penetrations. Duct insulation terminating at fire dampers, shall be continuous over the damper collar and retaining angle of fire dampers, which are exposed to unconditioned air and which may be prone to condensate formation. Duct insulation and vapor retarder shall cover the collar, neck, and any uninsulated surfaces of diffusers, registers and grills. Vapor retarder materials shall be applied to form a complete unbroken vapor seal over the insulation. Sheet Metal Duct shall be sealed in accordance with CEGS 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

3.3.2.1 Installation on Concealed Duct

- a. For rectangular, oval or round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 150 mm 6 inch wide strips on 300 mm (12 inch) centers.
- b. For rectangular and oval ducts, 600 mm (24 inches) and larger insulation shall be additionally secured to bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 400 mm (16 inch) centers and not more than 400 mm (16 inches) from duct corners.
- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 400 mm (16 inch) centers and not more than 400 mm 16 inches from duct corners.
- d. Insulation shall be impaled on the mechanical fasteners (self stick pins) where used and shall be pressed thoroughly into the adhesive. Care shall be taken to ensure vapor retarder jacket joints overlap 50 mm (2 inches). The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type duct hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used. The pin shall be trimmed back and bent over.
- f. Jacket overlaps shall be secured with staples and tape as necessary to ensure a secure seal. Staples, tape and seams shall be coated with a brush coat of vapor retarder coating.

- g. Breaks in the jacket material shall be covered with patches of the same material as the vapor retarder jacket. The patches shall extend not less than 50 mm (2 inches) beyond the break or penetration in all directions and shall be secured with tape and staples. Staples and tape joints shall be sealed with a brush coat of vapor retarder coating.
- h. At jacket penetrations such as hangers, thermometers, and damper operating rods, voids in the insulation shall be filled and the penetration sealed with a brush coat of vapor retarder coating.
- i. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish or tape with a brush coat of vapor retarder coating.. The coating shall overlap the adjoining insulation and uninsulated surface 50 mm (2 inches). Pin puncture coatings shall extend 50 mm (2 inches) from the puncture in all directions.
- j. Where insulation standoff brackets occur, insulation shall be extended under the bracket and the jacket terminated at the bracket.

3.3.2.2 Installation on Exposed Duct Work

- a. For rectangular ducts, rigid insulation shall be secured to the duct by mechanical fasteners on all four sides of the duct, spaced not more than 300 mm (12 inches) apart and not more than 75 mm (3 inches) from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 300 mm (12 inches) and larger. One row shall be provided for each side of duct less than 300 mm (12 inches).
- b. Duct insulation shall be formed with minimum jacket seams. Each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projections is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over. Vapor retarder jacket shall be continuous across seams, reinforcing, and projections. When height of projections is greater than the insulation thickness, insulation and jacket shall be carried over.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and the pin trimmed or bent over.
- d. Joints in the insulation jacket shall be sealed with a 100 mm (4 inch) wide strip of tape. Tape seams shall be sealed with a brush coat of vapor retarder coating.
- e. Breaks and ribs or standing seam penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 50 mm (2 inches) beyond the break or penetration and shall be secured with tape and stapled. Staples and joints shall be sealed with a brush coat of vapor retarder coating.
- f. At jacket penetrations such as hangers, thermometers, and damper operating rods, the voids in the insulation shall be filled and the penetrations sealed with a brush coat of vapor retarder coating.
- g. Insulation terminations and pin punctures shall be sealed and flashed with a reinforced vapor retarder coating finish. The coating shall overlap the adjoining insulation and uninsulated surface 50 mm (2 inches). Pin puncture coatings shall extend 50 mm (2 inches) from the puncture in all directions.
- h. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation with minimum density of 12 kg per cubic meter (3/4 pcf), attached as per MICA standards.

3.3.3 Insulation for Warm Air Duct

Insulation and vapor barrier shall be provided for the following warm air ducts and associated equipment:.

- a. Supply ducts.
- b. Return air ducts
- c. Relief air ducts
- d. Flexible runouts (field insulated)
- e. Plenums
- f. Duct-mounted coil casings
- g. Coil-headers and return bends
- h. Coil casings.
- i. Fresh air intake ducts
- j. Filter boxes
- k. Mixing boxes
- l. Supply fans
- m. Site-erected air conditioner casings
- n. Ducts exposed to weather

Insulation for rectangular ducts shall be flexible type where concealed, minimum density 12 kg per cubic meter (3/4 pcf); and rigid type where exposed, minimum density 48 kg per cubic meter (3 pcf). Insulation on exposed ducts shall be provided with a white, paintable, factory-applied Type II jacket, or finished with adhesive finish. Flexible type insulation shall be used for round ducts, minimum density 12 kg per cubic meter (3/4 pcf) with a factory-applied Type II jacket. Insulation on concealed duct shall be provided with a factory-applied Type II jacket. Adhesive finish where indicated to be used shall be accomplished by applying two coats of adhesive with a layer of glass cloth embedded between the coats. The total dry film thickness shall be approximately 2.0 mm (1/16 inch). Duct insulation shall be continuous through sleeves and prepared openings. Duct insulation shall terminate at fire dampers and flexible connections.

3.3.3.1 Installation on Concealed Duct

- a. For rectangular, oval and round ducts, insulation shall be attached by applying adhesive around the entire perimeter of the duct in 150 mm (6 inch) wide strips on 300 mm (12 inch) centers.
- b. For rectangular and oval ducts 600 mm (24 inches) and larger, insulation shall be secured to the bottom of ducts by the use of mechanical fasteners. Fasteners shall be spaced on 450 mm (18 inch) centers and not more than 450 mm 18 inches from duct corner.

- c. For rectangular, oval and round ducts, mechanical fasteners shall be provided on sides of duct risers for all duct sizes. Fasteners shall be spaced on 450 mm (18 inch) centers and not more than 450 mm (18 inches) from duct corners.
- d. The insulation shall be impaled on the mechanical fasteners where used. The insulation shall not be compressed to a thickness less than that specified. Insulation shall be carried over standing seams and trapeze-type hangers.
- e. Self-locking washers shall be installed where mechanical fasteners are used and the pin trimmed and bent over.
- f. Insulation jacket shall overlap not less than 50 mm (2 inches) at joints and the lap shall be secured and stapled on 100 mm (4 inch) centers.

3.3.3.2 Installation on Exposed Duct

- a. For rectangular ducts, the rigid insulation shall be secured to the duct by the use of mechanical fasteners on all four sides of the duct, spaced not more than 400 mm (16 inches) apart and not more than 150 mm (6 inches) from the edges of the insulation joints. A minimum of two rows of fasteners shall be provided for each side of duct 300 mm (12 inches) and larger and a minimum of one row for each side of duct less than 300 mm (12 inches).
- b. Duct insulation with factory-applied jacket shall be formed with minimum jacket seams, and each piece of rigid insulation shall be fastened to the duct using mechanical fasteners. When the height of projection is less than the insulation thickness, insulation shall be brought up to standing seams, reinforcing, and other vertical projections and shall not be carried over the projection. Jacket shall be continuous across seams, reinforcing, and projections. Where the height of projections is greater than the insulation thickness, insulation and jacket shall be carried over the projection.
- c. Insulation shall be impaled on the fasteners; self-locking washers shall be installed and pin excess clipped and bent over.
- d. Joints on jacketed insulation shall be sealed with a 100 mm (4 inch) wide strip of tape and brushed with vapor retarder coating.
- e. Breaks and penetrations in the jacket material shall be covered with a patch of the same material as the jacket. Patches shall extend not less than 50 mm (2 inches) beyond the break or penetration and shall be secured with adhesive and stapled.
- f. Insulation terminations and pin punctures shall be sealed with tape and brushed with vapor retarder coating.
- g. Oval and round ducts, flexible type, shall be insulated with factory Type I jacket insulation, minimum density of 12 kg per cubic meter (3/4 pcf) attached by staples spaced not more than 400 mm 16 inches and not more than 150 mm (6 inches) from the degrees of joints. Joints shall be sealed in accordance with paragraph 3.3.3.2 d.

3.3.4 Ducts Handling Air for Dual Purpose

For air handling ducts for dual purpose below and above 16 degrees C (60 degrees F), ducts shall be insulated as specified for cold air duct.

3.3.5 Insulation for Evaporative Cooling Duct

Evaporative cooling supply duct located in spaces not evaporatively cooled, shall be insulated. Material and installation requirements shall be as specified for duct insulation for warm air duct.

3.3.6 Duct Test Holes

After duct systems have been tested, adjusted, and balanced, breaks in the insulation and jacket shall be repaired in accordance with the applicable section of this specification for the type of duct insulation to be repaired.

3.3.7 Duct Exposed to Weather

3.3.7.1 Installation

Ducts exposed to weather shall be insulated and finished as specified for the applicable service for exposed duct inside the building. After the above is accomplished, the insulation shall then be further finished as detailed in the following subparagraphs.

3.3.7.2 Round Duct

Aluminum jacket with factory applied moisture retarder shall be applied with the joints lapped not less than 75 mm (3 inches) and secured with bands located at circumferential laps and at not more than 300 mm (12 inch) intervals throughout. Horizontal joints shall lap down to shed water and located at 4 or 8 o'clock position. Joints shall be sealed with caulking to prevent moisture penetration. Where jacketing abuts an uninsulated surface, joints shall be sealed with caulking.

3.3.7.3 Fittings

Fittings and other irregular shapes shall be finished as specified for rectangular ducts.

3.3.7.4 Rectangular Ducts

Two coats of weather barrier mastic reinforced with fabric or mesh for outdoor application shall be applied to the entire surface. Each coat of weatherproof mastic shall be 2.0 mm (1/16) inch minimum thickness. The exterior shall be a metal jacketing applied for mechanical abuse and weather protection, and secured with screws.

3.4 EQUIPMENT INSULATION INSTALLATION

3.4.1 General

Removable insulation sections shall be provided to cover parts of equipment which must be opened periodically for maintenance including vessel covers, fasteners, flanges and accessories. Equipment insulation shall be omitted on the following:

- a. Handholes.
- b. Boiler manholes.
- c. Cleanouts.
- d. ASME stamps.
- e. Manufacturer's nameplates.

3.4.2 Insulation for Cold Equipment

Cold equipment below 16 degrees C (60 degrees F): Insulation shall be furnished on equipment handling media below 16 degrees C (60 degrees F) including the following:

- a. Pumps.
- b. Cold water pumps.
- c. Pneumatic water tanks.
- d. Roof drain bodies.
- e. Air handling equipment parts that are not factory insulated.
- f. Expansion and air separation tanks.

3.4.2.1 Insulation Type

Insulation shall be suitable for the temperature encountered. Thicknesses shall be as follows:

- a. Equipment handling media between 2 and 16 degrees C (35 and 60 degrees F): 40 mm (1.5 inch) thick cellular glass, 25 mm (1 inch) thick flexible elastomeric cellular, 25 mm (1 inch) thick phenolic foam, or 25 mm (1 inch) thick polyisocyanurate foam.
- b. Equipment handling media between minus 18 degrees C and plus 1 degrees C (0 degree F and 34 degrees F): 75 mm (3 inch) thick cellular glass, 40 mm (1 1/2 inch) flexible elastomeric cellular, 40 mm 1 1/2 inch thick phenolic foam, or 40 mm (1 1/2 inch) thick polyisocyanurate foam.
- c. Equipment handling media between minus 34 degrees C and minus 18 degrees C (minus 30 degrees F and 1 degree F): 90mm (3 1/2 inch) thick cellular glass 45 mm (1 3/4 inch) thick flexible elastomeric cellular, 40 mm 1 1/2 inch thick phenolic foam, or 40 mm (1 1/2 inch) thick polyisocyanurate foam.

3.4.2.2 Pump Insulation

- a. Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Joints between sides and between sides and bottom shall be joined by adhesive with lap strips for rigid mineral fiber and contact adhesive for flexible elastomeric cellular insulation. The box shall conform to the requirements of MICA Insulation Stds plate No. 49 when using flexible elastomeric cellular insulation. Joints between top cover and sides shall fit tightly forming a female shiplap joint on the side pieces and a male joint on the top cover, thus making the top cover removable.
- b. Exposed insulation corners shall be protected with corner angles.
- c. Upon completion of installation of the insulation, including removable sections, two coats of vapor retarder coating shall be applied with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm (1/16 inch). A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. Caulking shall be applied to parting line, between equipment and removable section insulation, and at all penetrations.

3.4.2.3 Other Equipment

- a. Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- b. Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not more than 300 mm (12 inch) centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.
- c. Cellular glass and phenolic foam insulation shall be set in a coating of bedding compound, and joints shall be sealed with bedding compound as recommended by the manufacturer.
- d. Insulation on heads of heat exchangers shall be removable. Removable section joints shall be fabricated using a male-female shiplap type joint. The entire surface of the removable section shall be finished by applying two coats of vapor retarder coating with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm (1/16 inch).
- e. Exposed insulation corners shall be protected with corner angles.
- f. Insulation on equipment with ribs shall be applied over 150 x 150 mm (6 x 6 inches) by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 50 x 50 mm (2 x 2 inches) washers or shall be securely banded or wired in place on 300 mm (12 inch) centers.

3.4.2.4 Vapor Retarder

Upon completion of installation of insulation, penetrations shall be caulked. Two coats of vapor retarder coating shall be applied over insulation, including removable sections, with a layer of open mesh synthetic fabric embedded between the coats. The total dry thickness of the finish shall be 2.0 mm (1/16 inch). Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.3 Insulation for Hot Equipment

Insulation shall be furnished on equipment handling media above 16 degrees C (60 degrees F) including the following:

- a. Converters.
- b. Heat exchangers.
- c. Hot water generators.
- d. Water heaters.
- e. Pumps handling media above 54 degrees C (130 degrees F).
- f. Hot water storage tanks.
- g. Air separation tanks.
- h. Unjacketed boilers or parts of boilers.

- i. Boiler flue gas connection from boiler to stack (if inside).

3.4.3.1 Insulation

Insulation shall be suitable for the temperature encountered. Shell and tube-type heat exchangers shall be insulated for the temperature of the shell medium.

Insulation thickness for hot equipment shall be determined using Table IV:

Legend

RMF: Rigid Mineral Fiber
FMF: Flexible Mineral Fiber
CS: Calcium Silicate
PL: Perlite
CG: Cellular Glass
FC: Flexible Elastomeric Cellular
PF: Phenolic Foam
PC: Polyisocyanurate Foam

TABLE IV
Insulation Thickness for Hot Equipment (mm)

Equipment handling steam or other media to indicated pressure or temperature limit	Material	Thickness
103.4 kPa	RMF	50 mm
or	FMF	50 mm
121 C	CS/PL	100 mm
	CG	75 mm
	PF	40 mm
	FC (<93 C)	25 mm
	PC	25 mm
1379.0kPa	RMF	75 mm
or	FMF	75 mm
204 C	CS/PL	100 mm
	CG	100 mm
316 C	RMF	125 mm
	FMF	150 mm
	CS/PL	150 mm
	CG	150 mm

316 C: Thickness necessary to limit the external temperature of the insulation to 50 C, except that diesel engine exhaust piping and mufflers shall be covered with 150 mm thick material suitable for 650 degrees C service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

TABLE IV
Insulation Thickness for Hot Equipment (Inches)

Equipment handling steam or media to indicated pressure or temperature limit:	Material	Thickness
15 psig or 250F	RMF	2.0 inches
	FMF	2.0 inches
	CS/PL	4.0 inches
	CG	3.0 inches
	PF	1.5 inches
	FC (<200F)	1.0 inches
	PC	1.0 inches
200 psig or 400 F	RMF	3.0 inches
	FMF	3.0 inches
	CS/PL	4.0 inches
	CG	4.0 inches
600 F	RMF	5.0 inches
	FMF	6.0 inches
	CS/PL	6.0 inches
	CG	6.0 inches

>600 F: Thickness necessary to limit the external temperature of the insulation to 120F, except that diesel engine exhaust piping and mufflers shall be covered with 6.0 inch thick material suitable for 1200 degrees F service. Heat transfer calculations shall be submitted to substantiate insulation and thickness selection.

3.4.3.2 Insulation of Pumps

Pumps shall be insulated by forming a box around the pump housing. The box shall be constructed by forming the bottom and sides using joints which do not leave raw ends of insulation exposed. Bottom and sides shall be banded to form a rigid housing which does not rest on the pump. Joints between top cover and sides shall fit tightly. The top cover shall have a joint forming a female shiplap joint on the side pieces and a male joint on the top cover, making the top cover removable. Two coats of Class I adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. A parting line shall be provided between the box and the removable sections allowing the removable sections to be removed without disturbing the insulation coating. The total dry thickness of the finish shall be 2.0 mm. 1/16 inch. Caulking shall be applied to parting line of the removable sections and penetrations.

3.4.3.3 Other Equipment

- Insulation shall be formed or fabricated to fit the equipment. To ensure a tight fit on round equipment, edges shall be beveled and joints shall be tightly butted and staggered.
- Insulation shall be secured in place with bands or wires at intervals as recommended by the manufacturer but not greater than 300 mm (12 inch) centers except flexible elastomeric cellular which shall be adhered. Insulation corners shall be protected under wires and bands with suitable corner angles.

- c. On high vibration equipment, cellular glass insulation shall be set in a coating of bedding compound as recommended by the manufacturer, and joints shall be sealed with bedding compound. Mineral fiber joints shall be filled with finishing cement.
- d. Insulation on heads of heat exchangers shall be removable. The removable section joint shall be fabricated using a male-female shiplap type joint. Entire surface of the removable section shall be finished as specified.
- e. Exposed insulation corners shall be protected with corner angles.
- f. On equipment with ribs, such as boiler flue gas connection, draft fans, and fly ash or soot collectors, insulation shall be applied over 150 x 150 mm (6 x 6 inch) by 12 gauge welded wire fabric which has been cinched in place, or if approved by the Contracting Officer, spot welded to the equipment over the ribs. Insulation shall be secured to the fabric with J-hooks and 50 x 50 mm (2 x 2 inch) washers or shall be securely banded or wired in place on 300 mm (12 inch) (maximum) centers.
- g. On equipment handling media above 316 degrees C (600 degrees F), insulation shall be applied in two or more layers with joints staggered.
- h. Upon completion of installation of insulation, penetrations shall be caulked. Two coats of adhesive shall be applied over insulation, including removable sections, with a layer of glass cloth embedded between the coats. The total dry thickness of the finish shall be 2.0 mm (1/16 inch). Caulking shall be applied to parting line between equipment and removable section insulation.

3.4.4 Equipment Handling Dual Temperature Media

Below and above 16 degrees C (60 degrees F): equipment handling dual temperature media shall be insulated as specified for cold equipment.

3.4.5 Equipment Exposed to Weather

3.4.5.1 Installation

Equipment exposed to weather shall be insulated and finished in accordance with the requirements for ducts exposed to weather in paragraph DUCT INSULATION INSTALLATION.

3.4.5.2 Optional Panels

At the option of the Contractor, prefabricated metal insulation panels may be used in lieu of the insulation and finish previously specified. Thermal performance shall be equal to or better than that specified for field applied insulation. Panels shall be the standard catalog product of a manufacturer of metal insulation panels. Fastenings, flashing, and support system shall conform to published recommendations of the manufacturer for weatherproof installation and shall prevent moisture from entering the insulation. Panels shall be designed to accommodate thermal expansion and to support a 1112 N (250 pound) walking load without permanent deformation or permanent damage to the insulation. Exterior metal cover sheet shall be aluminum and exposed fastenings shall be stainless steel or aluminum.

END OF SECTION

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SECTION 15190
GAS PIPING SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN GAS ASSOCIATION (AGA)

AGA Manual (1994; Addenda/Correction Jan 1996) A.G.A. Plastic Pipe Manual for Gas Service

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.45 (1995) Flexible Connectors of Other Than All-Metal Construction for Gas Appliances

ANSI Z21.69 (1992; Z21.69a) Connectors for Movable Gas Appliances

AMERICAN PETROLEUM INSTITUTE (API)

API Spec 6D (1994; Supple 1 Jun 1996; Supple 2 Dec 1997) Pipeline Valves (Gate, Plug, Ball, and Check Valves)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 539 (1999) Electric-Resistance-Welded Coiled Steel Tubing for Gas and Fuel Oil Lines

ASTM B 88 (1999) Seamless Copper Water Tube

ASTM B 88M (1999) Seamless Copper Water Tube (Metric)

ASTM B 210 (1995a) Aluminum and Aluminum-Alloy Drawn Seamless Tubes

ASTM B 210M (1995) Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric)

ASTM B 241/B 241M (1999) Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube

ASTM B 280 (1999) Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

ASTM D 2513 (1999a) Thermoplastic Gas Pressure Pipe, Tubing, and Fittings

ASTM D 2517 (1999) Reinforced Epoxy Resin Gas Pressure Pipe and Fittings

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.33	(1990) Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (Sizes 1/2 through 2)
ASME B31.1	(1998) Power Piping
ASME B31.2	(1968) Fuel Gas Piping
ASME B36.10M	(1996) Welded and Seamless Wrought Steel Pipe
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 6/NACE 3	(1994) Commercial Blast Cleaning
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UNDERWRITERS LABORATORIES (UL)

UL Gas & Oil Dir	(1999) Gas and Oil Equipment Directory
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1.2 GENERAL REQUIREMENTS

1.2.1 Welding

Piping shall be welded in accordance with qualified procedures using performance qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified at least 24 hours in advance of tests and the tests shall be performed at the work site if practicable. The Contracting Officer shall be furnished with a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL.

1.2.2 Jointing Thermoplastic and Fiberglass Piping

Piping shall be jointed by performance qualified joiners using qualified procedures in accordance with AGA Manual. Plastic Pipe Manual for Gas Service. The Contracting Officer shall be furnished with a copy of qualified procedures and list of and identification symbols of qualified joiners.

1.2.3 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Asbestos or products containing asbestos shall not be used. Manufacturer's descriptive data and installation instructions shall be submitted for approval for compression-type mechanical joints used in joining dissimilar materials and for insulating joints. Valves, flanges and fittings shall be marked in accordance with MSS SP-25.

1.2.4 Verification of Dimensions

The Contractor shall become familiar with all details of the work, verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing the work.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Gas Piping System; G

Drawings showing location, size and all branches of pipeline; location of all required shutoff valves; and instructions necessary for the installation of connectors and supports.

SD-03 Product Data

Qualifications;

Qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

SD-6 Test Reports

Testing; Pressure Tests;
Pressure Tests for Liquefied Petroleum Gas;
Test With Gas;

Test reports in booklet form tabulating test and measurements performed. The reports shall be dated after award of this contract, shall state the contractor's name and address, shall name the project and location, and shall list the specific requirements which are being certified.

PART 2 PRODUCTS

2.1 PIPE AND FITTINGS

2.1.1 Steel Pipe, Joints, and Fittings

Steel pipe shall conform to ASME B36.10M. Malleable-iron threaded fittings shall conform to ASME B16.3. Steel pipe flanges and flanged fittings including bolts, nuts, and bolt pattern shall be in accordance with ASME B16.5. Wrought steel butt welding fittings shall conform to ASME B16.9. Socket welding and threaded forged steel fittings shall conform to ASME B16.11.

2.1.2 Aluminum Alloy Pipe and Tubing, Joints, and Fittings

Aluminum alloy pipe shall conform to ASTM B 241/B 241M, except alloy 5456 shall not be used, and the ends of each length of pipe shall be marked indicating it conforms to NFPA 54. Pipe joints shall be threaded, flanged, brazed or welded.

Aluminum alloy tubing shall conform to ASTM B 210M, ASTM B 210, Type A or B, or ASTM B 241/B 241M, Type A or equivalent. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

2.1.3 Copper Tubing, Joints and Fittings

Copper tubing shall conform to ASTM B 88M ASTM B 88, Type K or L, or ASTM B 280. Tubing joints shall be made up with tubing fittings recommended by the tubing manufacturer.

2.1.4 Steel Tubing, Joints and Fittings

Steel tubing shall conform to ASTM A 539. Tubing joints shall be made up with gas tubing fittings recommended by the tubing manufacturer.

2.1.5 Thermoplastic Pipe, Tubing, Joints, and Fittings

Thermoplastic pipe, tubing, joints and fittings shall not be used within buildings.

2.1.6 Fiberglass Pipe, Joints, and Fittings

Fiberglass piping systems shall not be used within buildings.

2.1.7 Sealants for Steel Pipe Threaded Joints

Joint sealing compound shall be listed in UL Gas & Oil Dir, Class 20 or less. Tetrafluoroethylene tape shall conform to UL Gas & Oil Dir.

2.1.8 Identification

Pipe flow markings and metal tags shall be provided as required.

2.1.9 Flange Gaskets

Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1.6 mm (1/16 inch) thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR) suitable for a maximum 316 degrees C (600 degrees F) service. NBR binder shall be used for hydrocarbon service.

2.1.10 Pipe Threads

Pipe threads shall conform to ASME B1.20.1.

2.1.11 Escutcheons

Escutcheons shall be chromium-plated steel or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or set screw.

2.1.12 Gas Transition Fittings

Gas transition fittings shall be manufactured steel fittings approved for jointing metallic and thermoplastic or fiberglass pipe. Approved transition fittings are those that conform to AGA Manual requirements for transition fittings.

2.1.13 Insulating Pipe Joints

2.1.13.1 Insulating Joint Material

Insulating joint material shall be provided between flanged or threaded metallic pipe systems where shown to control galvanic or electrical action.

2.1.13.2 Threaded Pipe Joints

Joints for threaded pipe shall be steel body nut type dielectric unions with insulating gaskets.

2.1.13.3 Flanged Pipe Joints

Joints for flanged pipe shall consist of full face sandwich-type flange insulating gasket of the dielectric type, insulating sleeves for flange bolts, and insulating washers for flange nuts.

2.1.14 Flexible Connectors

Flexible connectors for connecting gas utilization equipment to building gas piping shall conform to ANSI Z21.45. Flexible connectors for movable food service equipment shall conform to ANSI Z21.69.

2.2 VALVES

Valves shall be suitable for shutoff or isolation service and shall conform to the following:

2.2.1 Valves 50 mm (2 Inches) and Smaller

Valves 50 mm (2 inches) and smaller shall conform to ASME B16.33 and shall be of materials and manufacture compatible with system materials used.

2.2.2 Valves 65 mm (2-1/2 Inches) and Larger

Valves 65 mm (2-1/2 inches) and larger shall be carbon steel conforming to API Spec 6D, Class 150.

2.3 PIPE HANGERS AND SUPPORTS

Pipe hangers and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 METERS, REGULATORS AND SHUTOFF VALVES

Meters, regulators and shutoff valves shall be as specified in Section 02556 GAS DISTRIBUTION SYSTEM.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILLING

Earthwork shall be as specified in Section 02316 EXCAVATION, TRENCHING AND BACKFILLING FOR UTILITIES SYSTEMS.

3.2 GAS PIPING SYSTEM

Gas piping system shall be from the point of delivery, defined as the outlet of the meter set assembly located at each building and specified in Section 02556 GAS DISTRIBUTION SYSTEM, to the connections to each gas utilization device.

3.2.1 Protection of Materials and Components

Pipe and tube openings shall be closed with caps or plugs during installation. Equipment shall be protected from dirt, water, and chemical or mechanical damage. At the completion of all work, the entire system shall be thoroughly cleaned.

3.2.2 Workmanship and Defects

Piping, tubing and fittings shall be clear and free of cutting burrs and defects in structure or threading and shall be thoroughly brushed and chip-and scale-blown. Defects in piping, tubing or fittings shall not be repaired. When defective piping, tubing, or fittings are located in a system, the defective material shall be replaced.

3.3 PROTECTIVE COVERING

3.3.1 Underground Metallic Pipe

Buried metallic piping shall be protected from corrosion with protective coatings as specified in Section 02556 GAS DISTRIBUTION SYSTEM. When dissimilar metals are joined underground, gastight insulating fittings shall be used.

3.3.2 Aboveground Metallic Piping Systems

3.3.2.1 Ferrous Surfaces

Shop primed surfaces shall be touched up with ferrous metal primer. Surfaces that have not been shop primed shall be solvent cleaned. Surfaces that contain loose rust, loose mill scale and other foreign substances shall be mechanically cleaned by power wire brushing or commercial sand blasted conforming to SSPC SP 6/NACE 3 and primed with ferrous metal primer or vinyl type wash coat. Primed surface shall be finished with two coats of exterior oil paint or vinyl paint.

3.3.2.2 Nonferrous Surfaces

Except for aluminum alloy pipe, nonferrous surfaces shall not be painted. Surfaces of aluminum alloy pipe and fittings shall be painted to protect against external corrosion where they contact masonry, plaster, insulation, or are subject to repeated wettings by such liquids as water, detergents or sewage. The surfaces shall be solvent-cleaned and treated with vinyl type wash coat. A first coat of aluminum paint and a second coat of alkyd gloss enamel or silicone alkyd copolymer enamel shall be applied.

3.4 INSTALLATION

Installation of the gas system shall be in conformance with the manufacturer's recommendations and applicable provisions of NFPA 54, AGA Manual, and as indicated. Pipe cutting shall be done without damage to the pipe. Unless otherwise authorized, cutting shall be done by an approved type of mechanical cutter. Wheel cutters shall be used where practicable. On steel pipe 150 mm (6 inches) and larger, an approved gas cutting and beveling machine may be used. Cutting of thermoplastic and fiberglass pipe shall be in accordance with AGA Manual.

3.4.1 Metallic Piping Installation

Underground piping shall be buried a minimum of 450 mm (18 inches) below grade. Changes in direction of piping shall be made with fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Aluminum alloy pipe shall not be used in exterior locations or underground.

3.4.2 Metallic Tubing Installation

Metallic tubing shall be installed using gas tubing fittings approved by the tubing manufacturer. Branch connections shall be made with tees. All tubing end preparation shall be made with tools designed for the purpose. Aluminum alloy tubing shall not be used in exterior locations or underground.

3.4.3 Thermoplastic and Fiberglass Piping, Tubing, and Fittings

Thermoplastic and fiberglass piping, tubing, and fittings shall be installed outside and underground only. Piping shall be buried a minimum of 450 mm 18 inches below grade. The piping shall be installed to avoid excessive stresses due to thermal contraction. Thermoplastic and fiberglass piping shall only be allowed as indicated.

3.4.4 Connections Between Metallic and Plastic Piping

Connections shall be made only outside, underground, and with approved transition fittings.

3.4.5 Piping Buried Under Buildings

Underground piping installed beneath buildings shall be run in a steel pipe casing protected from corrosion with protective coatings as specified in Section 02556 GAS DISTRIBUTION SYSTEM. The casing shall extend at least 100 mm (4 inches) outside the building. The pipe shall have spacers and end bushings to seal at both ends to prevent the entrance of water and escape of gas. A vent line from the annular space shall extend above grade outside to a point where gas will not be a hazard and shall terminate in a rain- and insect-resistant fitting.

3.4.6 Concealed Piping in Buildings

When installing piping which is to be concealed, unions, tubing fittings, running threads, right- and left-hand couplings, bushings, and swing joints made by combinations of fittings shall not be used.

3.4.6.1 Piping in Partitions

Concealed piping shall be located in hollow rather than solid partitions. Tubing passing through walls or partitions shall be protected against physical damage.

3.4.6.2 Piping in Floors

Piping in solid floors except where embedment in concrete is indicated shall be laid in channels suitably covered to permit access to the piping with minimum damage to the building. Piping embedded in concrete shall be surrounded by a minimum of 40 mm (1-1/2 inches) of concrete and shall not be in physical contact with other metallic items such as reinforcing rods or electrically neutral conductors. Piping shall not be embedded in concrete slabs containing quickset additives or cinder aggregate.

3.4.7 Aboveground Piping

Aboveground piping shall be run as straight as practicable along the alignment indicated and with a minimum of joints. Piping shall be separately supported. Exposed horizontal piping shall not be installed farther than 150 mm (6 inches) from nearest parallel wall in laundry areas where clothes hanging could be attempted.

3.4.8 Final Gas Connections

Unless otherwise specified, final connections shall be made with rigid metallic pipe and fittings. Flexible connectors may be used for final connections to residential dryers. In addition to cautions listed in instructions required by ANSI standards for flexible connectors, insure that flexible connectors do not pass through equipment cabinet. Provide accessible gas shutoff valve, coupling, and union for each gas equipment item. At each gas equipment item without a gas train provide a line-size dirt leg downstream of the isolation valve.

3.5 PIPE JOINTS

Pipe joints shall be designed and installed to effectively sustain the longitudinal pull-out forces caused by contraction of the piping or superimposed loads.

3.5.1 Threaded Metallic Joints

Threaded joints in metallic pipe shall have tapered threads evenly cut and shall be made with UL approved graphite joint sealing compound for gas service or tetrafluoroethylene tape applied to the male threads only. Threaded joints up to 40 mm (1-1/2 inches) in diameter may be made with approved tetrafluoroethylene tape. Threaded joints up to 50 mm (2 inches) in diameter may be made with approved joint sealing compound. After cutting and before threading, pipe shall be reamed and burrs shall be removed. Caulking of threaded joints to stop or prevent leaks shall not be permitted.

3.5.2 Welded Metallic Joints

Beveling, alignment, heat treatment, and inspection of welds shall conform to ASME B31.2. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected adversely. Electrodes that have been wetted or have lost any of their coating shall not be used.

3.5.3 Thermoplastic and Fiberglass Joints

Jointing procedures shall conform to AGA Manual. Solvent cement or heat of fusion joints shall not be made between different kinds of plastics.

3.5.4 Flared Metallic Tubing Joints

Flared joints in metallic tubing shall be made with special tools recommended by the tubing manufacturer. Flared joints shall be used only in systems constructed from nonferrous pipe and tubing, when experience or tests have demonstrated that the joint is suitable for the conditions, and when adequate provisions are made in the design to prevent separation of the joints. Metallic ball sleeve compression-type tubing fittings shall not be used for tubing joints.

3.5.5 Solder or Brazed Joints

Joints in metallic tubing and fittings shall be made with materials and procedures recommended by the tubing supplier. Joints shall be brazed with material having a melting point above 538 degrees C (1000 degrees F) 1000 degrees F. Brazing alloys shall not contain phosphorous.

3.5.6 Joining Thermoplastic or Fiberglass to Metallic Piping or Tubing

When compression type mechanical joints are used, the gasket material in the fittings shall be compatible with the plastic piping and with the gas in the system. An internal tubular rigid stiffener shall be used in conjunction with the fitting, and the stiffener shall be flush with end of the pipe or tubing and shall extend at least to the outside end of the compression fitting when installed. The stiffener shall be free of rough or sharp edges and shall not be a force fit in the plastic. A split tubular stiffener shall not be used.

3.6 PIPE SLEEVES

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor or roof, and shall be cut flush with each surface, except in mechanical room floors not located on grade where clamping flanges or riser pipe clamps are used. Sleeves in mechanical room floors above grade shall extend at least 100 mm (4 inches) above finish floor. Unless otherwise indicated, sleeves shall be large enough to provide a minimum clearance of 6.4 mm (1/4 inch) all around the pipe. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe. Sleeves in nonbearing walls, floors, or ceilings may be steel pipe, galvanized sheet metal with lock-type longitudinal seam, or moisture-resistant fiber or plastic. For penetrations of fire walls, fire partitions and floors which are not on grade, the annular space between the pipe and sleeve shall be sealed with firestopping material and sealant that meet the requirement of Section 07840 FIRESTOPPING.

3.7 PIPES PENETRATING WATERPROOFING MEMBRANES

Pipes penetrating waterproofing membranes shall be installed as specified in Section 15400 PLUMBING, GENERAL PURPOSE.

3.8 FIRE SEAL

Penetrations of fire rated partitions, walls and floors shall be in accordance with Section 07840 FIRESTOPPING.

3.9 ESCUTCHEONS

Escutcheons shall be provided for all finished surfaces where gas piping passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms.

3.10 SPECIAL REQUIREMENTS

Drips, grading of the lines, freeze protection, and branch outlet locations shall be as shown and shall conform to the requirements of NFPA 54.

3.11 BUILDING STRUCTURE

Building structure shall not be weakened by the installation of any gas piping. Beams or joists shall not be cut or notched.

3.12 PIPING SYSTEM SUPPORTS

Gas piping systems in buildings shall be supported with pipe hooks, metal pipe straps, bands or hangers suitable for the size of piping or tubing. Gas piping system shall not be supported by other piping. Spacing of supports in gas piping and tubing installations shall conform to the requirements of NFPA 54. The selection and application of supports in gas piping and tubing installations shall conform to the requirements of MSS SP-69. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 3.2 mm (1/8 inch) shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

3.13 ELECTRICAL BONDING AND GROUNDING

The gas piping system within the building shall be electrically continuous and bonded to a grounding electrode as required by NFPA 70. Conventional flange joints allow sufficient current flow to satisfy this requirement.

3.14 SHUTOFF VALVE

Main gas shutoff valve controlling the gas piping system shall be easily accessible for operation and shall be installed as indicated, protected from physical damage, and marked with a metal tag to clearly identify the piping system controlled

3.15 TESTING

Before any section of a gas piping system is put into service, it shall be carefully tested to assure that it is gastight. Prior to testing, the system shall be blown out, cleaned and cleared of all foreign material. Each joint shall be tested by means of an approved gas detector, soap and water, or an equivalent nonflammable solution. Testing shall be completed before any work is covered, enclosed, or concealed. All testing of piping systems shall be done with due regard for the safety of employees and the public during the test. Bulkheads, anchorage and bracing suitably designed to resist test pressures shall be installed if necessary. Oxygen shall not be used as a testing medium.

3.15.1 Pressure Tests

Before appliances are connected, piping systems shall be filled with air or an inert gas and shall withstand a minimum pressure of 21 kPa (3 pounds gauge) for a period of not less than 10 minutes as specified in NFPA 54 without showing any drop in pressure. Oxygen shall not be used. Pressure shall

be measured with a mercury manometer, slope gauge, or an equivalent device so calibrated as to be read in increments of not greater than 1 kPa (0.1 pound). The source of pressure shall be isolated before the pressure tests are made.

3.15.2 Pressure Tests for Liquefied Petroleum Gas

Systems shall withstand the pressure test described above. When appliances are connected to the piping system, fuel gas shall be used for testing and appliances shall withstand a pressure of not less than 2.5 kPa nor more than 3.5 kPa (10.0 inches nor more than 14.0 inches water column) for a period of not less than 10 minutes without showing any drop in pressure. Pressure shall be measured with a water manometer or an equivalent device calibrated to be read in increments of not greater than 20 Pa (0.1 inch water column). The source of pressure shall be isolated before the pressure tests are made.

3.15.3 Test With Gas

Before turning gas under pressure into any piping, all openings from which gas can escape shall be closed. Immediately after turning on the gas, the piping system shall be checked for leakage by using a laboratory-certified gas meter, an appliance orifice, a manometer, or equivalent device. All testing shall conform to the requirements of NFPA 54. If leakage is recorded, the gas supply shall be shut off, the leak shall be repaired, and the tests repeated until all leaks have been stopped.

3.15.4 Purging

After testing is completed, and before connecting any appliances, all gas piping shall be fully purged. LPG piping tested using fuel gas with appliances connected does not require purging. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA 54 are followed.

3.15.5 Labor, Materials and Equipment

All labor, materials and equipment necessary for conducting the testing and purging shall be furnished by the Contractor.

3.16 PIPE COLOR CODE MARKING

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

END OF SECTION

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SECTION 15400

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 700	(1995; Apx C) Specifications for Fluorocarbon and Other Refrigerants
ARI 1010	(1994) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.10.1	(1993; Z21.10.1a; Z21.10.1b; Z21.10.1c) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	(1998) Gas Water Heaters Vol. III, Storage Water Heaters with Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous Water Heaters
ANSI Z21.22	(1986; Z21.22a) Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems
ANSI Z21.56	(1994; Z21.56a) Gas-Fired Pool Heaters
ANSI Z358.1	(1998) Emergency Eyewash and Shower Equipment

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 74	(1998) Cast Iron Soil Pipe and Fittings
ASTM A 105/A 105M	(1998) Carbon Steel Forgings for Piping Applications
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1999a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 515/A 515M	(1989; R 1997) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service

ASTM A 516/A 516M	(1990; R 1996) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 536	(1984; R 1999el) Ductile Iron Castings
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 888	(1998el) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 32	(1996) Solder Metal
ASTM B 42	(1998) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 111	(1998) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 111M	(1998) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock (Metric)
ASTM B 117	(1997) Operating Salt Spray (FOG) Apparatus
ASTM B 152	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 152M	(1997a) Copper Sheet, Strip, Plate, and Rolled Bar (Metric)
ASTM B 306	(1999) Copper Drainage Tube (DWV)
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 584	(1998a) Copper Alloy Sand Castings for General Applications
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1998) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C 564	(1997) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(1998) Elastomeric Joint Sealants

ASTM C 1053	(1990; R 1995el) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM D 638	(1999) Tensile Properties of Plastics
ASTM D 638M	(1998) Tensile Properties of Plastics (Metric)
ASTM D 1004	(1994a) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(1998) Polyethylene Plastics Molding and Extrusion Materials
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2235	(1996a) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(1999) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(1999a) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(1999) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 1996) Evaluating Coatings for High Temperature Service
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe and Fittings
ASTM D 2661	(1997ael) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(1998) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

ASTM D 2737	(1999) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997el) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(1995) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(1995) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(1995) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(1997) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(1997) PTFE Resin Skived Tape
ASTM D 3311	(1994) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(1995) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(1999) Propylene Plastic Injection and Extrusion Materials
ASTM D 4551	(1996) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM E 1	(1998) ASTM Thermometers
ASTM E 96	(1995) Water Vapor Transmission of Materials
ASTM F 409	(1999a) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80

ASTM F 438	(1999) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(1999) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(1999) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(1999e1) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core
ASTM F 877	(2000) Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold Water Distribution Systems
ASTM F 891	(1998e1) Coextruded Poly(Vinyl Chloride) (PVC) Plastic Pipe with a Cellular Core
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F 1760	(1997) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 34	(1997) Number Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(1989; 90.1b; 90.1c; 90.1d; 90.1e; 90.1g; 90.1i; 90.1l-1995; 90.1m-1995; 90.1n-1997) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 1998) Air Gaps in Plumbing Systems
ASME A112.6.1M	(1997) Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.14.1	(1975; R 1998) Backwater Valves
ASME A112.18.1M	(1996) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; R 1999) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures

ASME A112.19.3M	(1987; R 1996) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; Errata Nov 1996) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.1M	(1991; R 1998) Floor Drains
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991; R 1998) Cleanouts
ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(1992; Errata Jan 1994) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(1991; R 1998) Cast Copper Alloy Pipe Flanges, Class 150, 300, 400, 600, 900, 1500, and 2500, and Flanged Fittings, Class 150 and 300
ASME B16.29	(1994) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element

ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1998) Controls and Safety Devices for Automatically Fired Boilers

AMERICAN SOCIETY OF SANITARY ENGINEERING FOR PLUMBING AND SANITARY RESEARCH(ASSE)

ASSE 1001	(1990) Pipe Applied Atmospheric Type Vacuum Breakers
ASSE 1002	(1986) Water Closet Flush Tank Ball Cocks
ASSE 1003	(1995) Water Pressure Reducing Valves for Domestic Water Supply Systems
ASSE 1005	(1986) Water Heater Drain Valves - 3/4-Inch Iron Pipe Size
ASSE 1006	(1989) Residential Use (Household) Dishwashers
ASSE 1011	(1995) Hose Connection Vacuum Breakers
ASSE 1012	(1995) Backflow Preventers with Intermediate Atmospheric Vent
ASSE 1013	(1993) Reduced Pressure Principle Backflow Preventers
ASSE 1018	(1986) Trap Seal Primer Valves Water Supply Fed
ASSE 1020	(1998) Pressure Vacuum Breaker Assembly (Recommended for Outdoor Usage)
ASSE 1037	(1990; Rev through Mar 1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA EWW	(1999) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(1999) Hypochlorites
AWWA B301	(1992; Addenda B301a - 1999) Liquid Chlorine
AWWA C105	(1993) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(1997; addenda C203a - 1999) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints

AWWA C700 (1995) Cold-Water Meters - Displacement Type, Bronze Main Case

AWWA D100 (1996) Welded Steel Tanks for Water Storage

AWWA M20 (1973) Manual: Water Chlorination Principles and Practices

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8 (1992) Filler Metals for Brazing and Braze Welding

AWS B2.2 (1991) Brazing Procedure and Performance Qualification

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (1997) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI 310 (1997) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

CISPI HSN-85 (1985) Neoprene Rubber Gaskets for Hub and Spigot Cast Iron Soil Pipe and Fittings

CODE OF FEDERAL REGULATIONS (CFR)

10 CFR 430 Energy Conservation Program for Consumer Products

21 CFR 175 Indirect Food Additives: Adhesives and Components of Coatings

PL 93-523 (1974; Amended 1986) Safe Drinking Water Act

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-240 (Rev A; Canc. Notice 1) Shower Head, Ball Joint

CID A-A-50012 (Basic) Garbage Disposal Machine, Commercial

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook (1995) Copper Tube Handbook

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR-01 (1993) Manual of Cross-Connection Control

HYDRAULIC INSTITUTE (HI)

HI 1.1-1.5 (1994) Centrifugal Pumps

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO Z124.1 (1995) Plastic Bathtub Units

IAPMO Z124.3	(1995) Plastic Lavatories
IAPMO Z124.5	(1997) Plastic Toilet (Water Closets) Seats
IAPMO Z124.6	(19xx) Plastic Mop Sinks
IAPMO Z124.9	(1994) Plastic Urinal Fixtures

INTERNAL CODE COUNCIL (ICC)

CABO A117.1	(1998) Accessible and Usable Buildings and Facilities
ICC Plumbing Code	(2000) International Plumbing Code (IPC)

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(1996) Steel Pipeline Flanges
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(1995) Butterfly Valves
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(1995) Class 3000 Steel Pipe Unions Socket-Welding and Threaded
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ASSOCIATION OF PLUMBING-HEATING-COOLING CONTRACTORS
(NAPHCC)

NAPHCC Plumbing Code (1996) National Standard Plumbing Code

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250 (1997) Enclosures for Electrical Equipment (1000 Volts
Maximum)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31 (1997; TIA 97-1) Installation of Oil Burning Equipment

NFPA 54 (1999) National Fuel Gas Code

NFPA 90A (1999) Installation of Air Conditioning and Ventilating
Systems

NSF INTERNATIONAL (NSF)

NSF 3 (1996) Commercial Spray-Type Dishwashing and
Glasswashing Machines

NSF 5 (1992) Water Heaters, Hot Water Supply Boilers, and Heat
Recovery Equipment

NSF 14 (1999) Plastics Piping Components and Related Materials

NSF 61 (1999) Drinking Water System Components - Health Effects
(Sections 1-9)

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01 (1999) Plastic Pipe in Fire Resistive Construction

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI G 101 (1996) Testing and Rating Procedure for Grease Interceptors
with Appendix of Sizing and Installation Data

PDI WH 201 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE J 1508 (1997) Hose Clamps

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5/NACE 1 (1994) White Metal Blast Cleaning

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996; Rev through Oct 1999) Household Electric Storage
Tank Water Heaters

UL 430	(1994; Rev through Nov 1996) Waste Disposers
UL 732	(1995; Rev through Jan 1999) Oil-Fired Storage Tank Water Heaters
UL 749	(1997; Rev through Feb 1999) Household Dishwashers
UL 921	(1996) Commercial Electric Dishwashers

1.2 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

1.3 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment, at the specified capacity, and including an allowable service factor.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Plumbing System; G

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; flexible connections for seismic building joints, anchor points and expansion loops for thermal expansion, dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

Complete calculations shall be submitted for all thermal expansion and seismic joints. Calculations shall be performed by a licensed engineer. See specification Section 15070 Seismic Protection For Mechanical Equipment.

Electrical Schematics; G

Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device.

Hot Water Heaters, Storage Tank, and Circulation System Details; G

Detail drawings for the hot water heaters, storage tanks, and circulation system including physical dimensions of each component, location and sizes of all connections shall be developed. Detailed drawings for the hot water system shall demonstrate coordination between all supply and return connections, pipe sizes, and supporting equipment/appurtenances. Drawings shall include complete sequence of operations for the system demonstrating that all system components have been coordinated, and that the controls have been coordinated. Detail drawings shall be drawn to scale.

SD-03 Product Data

Welding;

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Plumbing Fixture Schedule; G

Catalog cuts of specified plumbing fixtures, valves, and related piping systems, and locations where installed.

Vibration-Absorbing Features;

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Plumbing System;

Diagrams, instructions, and other sheets proposed for posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection;

Test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

Backflow Prevention Assembly Tests;

Certification of proper operation shall be as accomplished in accordance with state regulations by an individual certified by the state to perform such tests. If no state requirement exists, the Contractor shall have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. The Contractor shall provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Materials and Equipment;

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

Bolts;

Written certification by the bolt manufacturer that the bolts furnished comply with the specified requirements. The certification shall include illustrations of product-required markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Plumbing System; G

Six copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. The manual shall include the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. Six copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL

1.5.2 Cathodic Protection

Cathodic protection and shall be in accordance with paragraph Corrosion Protection for Buried Pipe and Fittings.

1.6 REGULATORY REQUIREMENTS

Plumbing work shall be in accordance with ICC Plumbing Code.

1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

PART 2 PRODUCTS

2.1 MATERIALS

Materials for various services shall be in accordance with TABLES I and II. Pipe schedules shall be selected based on service requirements. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used cold water service (non-potable water) to the water closets shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, Section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking must meet the requirements of NSF 61, Section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs, or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall be used only for the cold water piping servicing the water closets. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joints and gasket materials shall conform to the following:

- a. Coupling for Cast-Iron Pipe: for hub and spigot type ASTM A 74, AWWA C606. For hubless type: CISPI 310
- b. Coupling for Steel Pipe: AWWA C606.
- c. Couplings for Grooved Pipe: Ductile Iron ASTM A 536 (Grade 65-45-12), Malleable Iron ASTM A 47/A 47M, Grade 32510, Copper ASTM A 536.
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with ASME B16.21. Gaskets shall be flat, 1.6 mm (1/16 inch) thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Neoprene Gaskets for Hub and Cast-Iron Pipe and Fittings: CISPI HSN-85.
- f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- h. Solder Material: Solder metal shall conform to ASTM B 32.
- i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

- k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 110 degrees C (230 degrees F).
- m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.
- o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.
- t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrestor: PDI WH 201.
- b. Copper, Sheet and Strip for Building Construction: ASTM B 370.
- c. Asphalt Roof Cement: ASTM D 2822.
- d. Hose Clamps: SAE J 1508.
- e. Supports for Off-The-Floor Plumbing Fixtures: ASME A112.6.1M.
- f. Metallic Cleanouts: ASME A112.36.2M.
- g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.
- h. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines:
AWWA C203.
- i. Hypochlorites: AWWA B300.
- j. Liquid Chlorine: AWWA B301.

- k. Polyethylene Encasement for Ductile-Iron Piping: AWWA C105.
- l. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.1.
- m. Thermometers: ASTM E 1.

2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm (3 inches) and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

<u>Description</u>	<u>Standard</u>
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves, Socket Welding and Threaded Ends	ASME B16.34
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003

Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

PIPING 2.3.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, P-trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded countersunk plugs.

2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm (3/4 inch) male inlet threads, hexagon shoulder, and 20 mm (3/4 inch) hose connection. Faucet handle shall be securely attached to stem.

2.3.3 Wall Hydrants

Wall hydrants with vacuum-breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through the wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removable through the face of the hydrant. The hydrant shall have 20 mm (3/4 inch) exposed hose thread on spout and 20 mm (3/4 inch) male pipe thread on inlet.

2.3.4 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 20 mm (3/4 inch) pipe. Body shall be suitable for wrench grip. Faucet spout shall have 20 mm (3/4 inch) exposed hose threads. Faucet handle shall be securely attached to stem.

2.3.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.3.6 Relief Valves

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least

equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) shall have 20 mm (3/4 inch) minimum inlets, and 20 mm (3/4 inch) outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) shall have 25 mm (1 inch) minimum inlets, and 25 mm (1 inch) outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.7 Thermostatic Mixing Valves

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C (5 degrees F) of any setting.

2.3.8 Seismic Loop Joints

Seismic loop joints shall be flexible hose type expansion joints consisting of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree return. Where nested loops are required or provided, the 180 degree return may be two 90's separated by either a third section of hose and braid, or a straight section of pipe with two 90 degree elbows. Loops shall be installed in a neutral condition for all seismic type joints. The seismic loop joints shall be anchored to the structure on both sides of the building seismic joint, unless the seismic joint is concurrently being used to accommodate thermal expansion. Where the loops act both for seismic protection and thermal expansion, the loop shall be capable of providing the necessary seismic deflections in both the contracted and expanded conditions of the piping system. The pipe shall be anchored and guided sufficiently to ensure that axial loads in compression do not cause buckling given the concurrent seismic loads that would be imposed horizontally along the length of the pipe. Seismic loop joints for potable water service shall be of all stainless steel construction.

2.4 FIXTURES

Fixtures shall be water conservation type, in accordance with ICC Plumbing Code. Fixtures for use by the physically handicapped shall be in accordance with CABO A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps, faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degrees C (180 degrees F) water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

2.4.1 Lavatories

Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled. Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.

2.5 BACKFLOW PREVENTERS

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with FCCCHR-01. Backflow preventers with intermediate atmospheric vent shall conform to ASSE 1012. Reduced pressure principle backflow preventers shall conform to ASSE 1013. Hose connection vacuum breakers shall conform to ASSE 1011. Pipe applied atmospheric type vacuum breakers shall conform to ASSE 1001. Pressure vacuum breaker assembly shall conform to ASSE 1020. Air gaps in plumbing systems shall conform to ASME A112.1.2.

2.6 DRAINS

2.6.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drainpipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to ASTM C 564 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to ASME A112.21.1M.

2.6.1.1 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.6.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square with a 300 mm (12 inch) nominal overall width or diameter and 250 mm (10 inch) nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drain pipe. Drains shall conform to ASME A112.21.1M.

2.6.3 Floor Sinks

Floor sinks shall be circular or square, with 300 mm (12 inch) nominal overall width or diameter and 250 mm (10 inch) nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connecting pipe.

2.6.4 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.6.5 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze, or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular, unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

Area of strainer and collar 0.023 square meters (36 square inches)

Height of funnel 95 mm (3-3/4 inches)

Diameter of lower portion of funnel 50 mm (2 inches)

Diameter of upper portion of funnel 100 mm (4 inches)

2.6.6 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M, with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing. The whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 3.416 mm (0.134 inch). Gaskets and packing shall be close-cell neoprene, O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 4.9 kg per square meter (16 ounce) 16 ounce weight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 1.016 mm (0.040 inch) minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with ASTM D 4551.

2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 1.016 mm (0.040 inch) minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. ASTM D 638M or ASTM D 638:

Ultimate Tensile Strength: 1.79 MPa (2600 psi)
Ultimate Elongation: 398 percent
100 Percent Modulus: 3.07 MPa (445 psi)

b. ASTM D 1004:

Tear Strength: 53 kilonewtons per meter (300 pounds per inch)

c. ASTM E 96:

Permeance: 0.46 μg per Pa per second per square meter (0.008 perms)

d. Other Properties:

Specific Gravity: 1.29
PVC Solvent: Weldable
Cold Crack: minus 47 degrees C (-53 degrees F) Dimensional stability,
100 degrees C (212 minus 2.5 percent degrees F) minus 2.5 percent
Hardness, Shore A: 89

2.8 TRAPS

Unless otherwise specified, traps shall be plastic per ASTM F 409 or copper-alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.813 mm (0.032 inch) inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm (2 inches). The interior diameter shall be not more than 3.2 mm (1/8 inch) over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A copper alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast brass wall flange shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.8.1 TRAP PRIMERS

Trap primers shall be installed on all floor drains in accordance with the Uniform Plumbing Code and ASSE 1018.

2.9 WATER HEATERS

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C (90 to 160 degrees F). For other than barracks facilities, hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to TABLE III for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 liters (500 gallons) storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.9.1 Automatic Storage Type

Heaters shall be complete with control system, temperature gauge, and pressure gauge, and shall have ASME rated combination pressure and temperature relief valve. A phenolic resin coating shall be provided.

2.9.1.1 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 22 kW (75,000 BTU per hour) 75,000 BTU per hour or less or ANSI Z21.10.3 for heaters with input greater than 22 kW (75,000 BTU per hour). 75,000 BTU per hour. A phenolic resin coating shall be provided.

2.9.1.2 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 kW. The elements shall be wired so that only one element can operate at a time. A phenolic resin coating shall be provided.

2.9.2 Phenolic Resin Coatings

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The coil shall be chemically cleaned to remove any scale if present and to etch the metal surface. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5/NACE 1. The coating shall be a product specifically intended for use on the material the water heating coils are made of and shall be acceptable for use in potable water systems. Steel, copper, copper alloy, or stainless steel coatings shall be capable of withstanding temperatures up to 204 degrees C (400 degrees F) dry bulb; and meet the requirements of 21 CFR 175. The entire exterior surface and the first 125 mm (5 inches) to 200 mm (8 inches) inside the tubes of each coil shall be coated with three component phenolic resin coating system. The system shall consist of the following: wash primer, pigmented base coat, and the clear top coat. Immediate and final cure times and temperatures shall be as recommended by the coating manufacturer.

2.9.2.1 Wash Primer

The wash primer shall be composed of a combination of polyvinyl butyral and a heat hardening phenolic resin. The weight per liter (gallon) shall be between 0.8388 kg per liter (7.0 lbs. per gallon) minimum and 0.8867 kg per liter (7.4 lbs. per gallon) maximum.

2.9.2.2 Pigmented Base Coat

The pigmented baking phenolic base coat shall consist of heat hardening phenolic resins, suitable pigments of the earth type, and softening agents, and shall not contain drying oils or cellulose material. The weight per liter (gallon) shall be between 1.2 kg per liter (10.3 lbs per gallon) minimum and 1.3 kg per liter (10.7 lbs per gallon) maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

2.9.2.3 Clear Top Coat

The clear non-pigmented baking phenolic top coat shall have a weight per liter (gallon) of between 1.0 kg per liter (8.65 lbs per gallon) minimum and 1.1 kg per liter (8.95 lbs per gallon) maximum. The non-volatile solids content shall be between 48 percent minimum and 52 percent maximum by weight.

2.9.2.4 Certificate of Compliance

A certificate of compliance shall be submitted by the coating manufacturer that documents successful use of coating system under service conditions indicated on the drawings for a minimum of 2 years at three different locations, and that the coating material and application comply with the testing procedures outlined.

2.9.2.5 Test Panels

Steel test panel substrate shall be 0.607 mm (24 gauge) in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 0.10 to 0.15 mm, 4 to 6 mil, then clear baking phenolic to a total dry film thickness of 0.13 to 0.18 mm (5 to 7 mil). The panels shall then be subjected to the tests specified below:

- a. Heat Test: Test panel shall be minimum 70 x 150 mm (2-3/4 x 5-7/8 inches) in size. A coated test panel shall show no cracking, flaking, or other failure after the panel has been tested in accordance with ASTM D 2485, with a furnace temperature of 204 degrees C (400 degrees F).
- b. Abrasion Test: A coated test panel shall show no more than a 40 milligram loss when tested in accordance with ASTM D 4060, utilizing a Tabor Abraser CS-17F wheel with a 1000 g weight for 1000 cycles.
- c. Corrosion Test: A coated test panel shall show no corrosion after being subjected to a 500 hour salt spray test in accordance with ASTM B 117.

2.10 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, in accordance with ASME BPV VIII, Div 1, and ASME stamped for the working pressure of at least 517 kPa (125 psi), and shall have the National Board (ASME) registration. The tank shall be stainless steel (304L Mill Finished) type in accordance with applicable portions of AWWA D100. The heat loss shall as a minimum, conform to TABLE III as determined by the requirements of ASHRAE 90.1. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm (7 inch) scale. Thermometer shall have a separable socket suitable for a 20 mm (3/4 inch) tapped opening. Tanks shall be equipped with a pressure gauge 155 mm (6 inch) minimum diameter face.

2.10.1 HOT-WATER STORAGE TANK CONNECTIONS

In addition to that indicated above, each tank shall be equipped with five 76 mm (3 inch) flanged connections for demand flow operation, one for the hot/cold water outlet at the top of the tanks, and

four for cold water inlet openings at the bottom of the tanks. The four inlet connections at the bottom of the tank shall be designed to distribute cold water to the bottom of the tank quiescently to provide temperature stratification and to prevent mixing of cold and hot water. Tanks shall be equipped with 38 mm (1-1/2 inch) hot water supply connections at the top of the tanks, and 38 mm (1-1/2 inch) hot water recirculation outlets at the bottom of the tanks, a 32mm (1-1/4 inch) relief connection, and a 38 mm (1-1/2 inch) drain connection shall also be provided. A 280 mm x 380 mm (11" x 15") manhole shall be provided as required by ASME BPV VIII Div 1. Additional taps for thermometers shall be as indicated. Insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.11 PUMPS

2.11.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. The pumps shall be direct-connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 or 4 enclosure as most applicable to the location. Each pump shall be fitted with a high-grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type 1 or 4 enclosure (as most applicable to the location), shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.11.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be integrally mounted on a cast-iron or steel subbase, close-coupled with an overhung impeller, or supported by the piping on which it is installed, as indicated. The shaft shall be one-piece, heat-treated, corrosion-resisting steel with impeller and smooth-surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage (horsepower) horsepower for the service required. Pump shall conform to HI 1.1-1.5. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 746 W (Fractional horsepower pump motors) shall have integral thermal overload protection in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Guards shall shield exposed moving parts.

2.11.3 Booster Pumps

2.11.3.1 Centrifugal Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished. The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze wearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be

machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in liters per second (gpm), head in meters (feet), efficiency, brake wattage (horsepower), and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

2.11.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line-type magnetic controller complete in a NEMA 250 Type 1 enclosure with three position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously beeping a third pump as a standby.

2.11.4 Flexible Connectors

Flexible connectors shall be provided at the suction and discharge of each pump that is 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with Class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.12 DOMESTIC WATER SERVICE METER

Cold water meter shall be of the positive displacement type conforming to AWWA C700. Meter register may be round or straight reading type. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories. Meters shall be installed in the mechanical rooms of the building it serves.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m (5 feet) outside the building, unless otherwise indicated. A gate valve and drain shall be installed on the water service line inside the building approximately 150 mm (6 inches) above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm (12 inches) below the finish grade or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with control no lower than the valve body.

3.1.1 Water Pipe, Fittings, and Connections

3.1.1.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot-water and cold-water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.1.1.3 Protection of Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.1.1.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 12 mm (1/2 inch) between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.1.1.5 Pipe Drains

Pipe drains shall consist of 20 mm (3/4 inch) hose bibb with renewable seat and ball valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.1.1.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot-water and hot-water circulation riser and run shall have expansion loops or other provisions such as offsets, changes in direction, etc., where indicated and/or required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m (50 feet) in length shall be anchored to the wall or the supporting construction about

midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer. Location of flexible connectors and offsets may be coordinated with the locations of seismic joints to accommodate thermal expansion along with the seismic flexibility requirements as indicated.

3.1.1.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 100 mm (4 inches) in diameter or larger shall be provided with thrust blocks, where indicated, to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa (2000 psi) after 28 days. Blocking shall be placed between solid ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing will be as shown. Blocking shall be placed so that the joints of the fitting are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.1.1.8 Commercial-Type Water Hammer Arresters

Commercial-type water hammer arresters shall be provided on hot- and cold-water supplies and shall be located to serve each fixture group with larger than three flush valves and as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to PDI WH 201. Vertical capped pipe columns will not be permitted.

3.1.3 Joints

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.1.3.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of the pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.3 Unions and Flanges

Unions, flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm (2-1/2 inches) and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) and larger.

3.1.3.4 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.3.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

3.1.3.6 Copper Tube and Pipe

The tube or fittings shall not be annealed when making connections.

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm (2 inches) and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.
- c. Copper Tube Extracted Joint. An extracted mechanical joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. Branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed in accordance with NAPHCC Plumbing Code using B-cup series filler metal in accordance with MSS SP-73. Soldered extracted joints will not be permitted.

3.1.3.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

3.1.3.8 Seismic Loop Joints

Seismic loop joints shall be installed in accordance with manufacturer's recommendations, the requirements herein, and in accordance with Section 15070 Seismic Protection For Mechanical Equipment.

3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fitting for the specific purpose.

3.1.5 Corrosion Protection for Buried Pipe and Fittings

3.1.5.1 Cast Iron and Ductile Iron

Pressure pipe shall have protective coating, a cathodic protection system, and joint bonding. Pipe, fittings, and joints shall have a protective coating. The protective coating shall be completely encasing polyethylene tube or sheet in accordance with AWWA C105. Joints and fittings shall be cleaned, coated with primer, and wrapped with tape. The pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.5.2 Steel

Steel pipe, joints, and fittings shall be cleaned, coated with primer, and wrapped with tape. Pipe shall be cleaned, coated, and wrapped prior to pipe tightness testing. Joints and fittings shall be cleaned, coated, and wrapped after pipe tightness testing. Tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer shall be as recommended by the tape manufacturer.

3.1.6 Pipe Sleeves and Flashing

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.1.6.1 Sleeve Requirements

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical

equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm (4 inches) above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm (1/4 inch) clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam, or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with a primer, backstop material and surface preparation as specified in Section 07900 JOINT SEALING. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm (1/2 inch) from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and concrete or masonry wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter (16 ounce) copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm (10 inches). For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using lead or copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm (8 inches) from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm (10 inches) in diameter, passing through roof or floor waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.1.6.3 Waterproofing

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm (1-1/2 inches) to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned-down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm (1-1/2 inches); then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm (8 inches) from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm (1-1/2 inches) to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be sealed.

3.1.6.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 6 to 13 mm (1/4 to 1/2 inch) wide by 6 to 10 mm (1/4 to 3/8 inch) deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07900 JOINT SEALING.

3.1.7 Fire Seal

Where pipes pass through fire walls, fire-partitions, fire-rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run. Threaded sections of rods shall not be formed or bent.

3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 100 mm (4 inches).
 - (2) Be used on insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C (60 degrees F) or less.
 - (3) Have a high density insert for all pipe sizes. High density inserts shall have a density of 128 kg per cubic meter (8 pcf) 8 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m (5 feet) apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C (120 degrees F) for PVC and 82 degrees C (180 degrees F) for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m (15 feet) nor more than 2 m (8 feet) from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint the following may be used:
 - (1) On pipe 100 mm (4 inches) and larger when the temperature of the medium is 15 degrees C (60 degrees F) or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
 - (2) On pipe less than 100 mm (4 inches) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
 - (3) On pipe 100 mm (4 inches) and larger carrying medium less than 15 degrees C (60 degrees F) a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.
- m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm (4 inches) or by an amount adequate for the insulation, whichever is greater.

- n. Hangers and supports for plastic pipe shall not compress, distort, cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

3.1.9 Welded Installation

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package, it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.10 Pipe Cleanouts

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm (4 inches) will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra-heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where indicated, shall be T-pattern, 90-degree branch drainage fittings with cast-brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm (4 inches). Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm (18 inches) of crawl space is provided under the floor. Cleanouts on pipe concealed in partitions shall be provided with chromium plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to the plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the heads shall be cast iron.

3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

3.2.1 Relief Valves

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T valve shall be installed in the hot-water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot-water storage tank or water heater and mounted above and within 150 mm (6 inches) above the top of the tank or water heater.

3.2.2 Installation of Gas-Fired Water Heater

Installation shall conform to NFPA 54. Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlet. Circulating systems need not have heat traps installed. An acceptable heat trap may be a

piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm (24 inches) just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods may also be approved. A phenolic resin coating shall be provided.]

3.2.3 Phenolic Resin Application Process

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5/NACE 1. The exterior surface shall be coated with the three-component coating system in the following sequence and manner. For immediate and final cure times and temperature, the recommendations of the coating manufacturer shall be followed.

- a. Wash Primer. One coat of wash primer shall be applied by flooding.
- b. Pigmented Base Coat. Pigmented baking phenolic coating shall be applied in several coats by immersion or flooding to a dry film thickness of 0.10 to 0.15 mm (4 to 6 mils).
- c. Clear Top Coat. Clear non-pigmented baking phenolic top coat shall be applied in several coats by immersion or flooding. The final coat may be applied by spraying. The dry film thickness of the total coating system shall be between 0.13 and 0.18 mm (5 and 7 mils).

3.2.4 Heat Traps

Manufacturers standard heat traps shall be provided for the cold water inlet and hot water outlet at the water heater.

3.2.5 Connections to Water Heaters

Connections of metallic pipe to water heaters shall be made with dielectric unions or flanges.

3.3 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown.

3.3.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.3.2 Flushometer Valves

Flushometer valves shall be secured to prevent movement by anchoring the long finished top spud connecting tube to wall adjacent to valve with approved metal bracket. Flushometer valves for water closets shall be installed 1 m (39 inches) above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 760 mm (30 inches) above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure. Bumpers for water closet seats shall be installed on the wall, flushometer stop, or flushometer spud.

3.3.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm (31 inches) above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm (42 inches) above floor. Wall-hung service sinks shall be mounted with rim 700 mm (28 inches) above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with CABO A117.1.

3.3.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.3.5 Fixture Supports

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair-carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.3.5.1 Support for Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.3.5.2 Support for Concrete-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the concrete wall using through bolts and a back-up plate.

3.3.5.3 Support for Steel Stud Frame Partitions

Chair carrier shall be used. The anchor feet and tubular uprights shall be of the heavy duty design; and feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, shall be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 6 mm (1/4 inch) thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.3.5.5 Wall-Mounted Water Closet Gaskets

Where wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair-carrier manufacturer.

3.3.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC Plumbing Code at all other locations necessary to preclude a cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.3.7 Access Panels

Access panels shall be provided for concealed valves and controls, or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METAL.

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm (2 inches) above the flood rim of the funnel to provide an acceptable air gap.

3.3.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast-iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

3.3.10 Shower Pans

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor.

3.3.10.1 General

The floor of each individual shower, the shower-area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curb or partition, shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 150 mm (6 inches) for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flatlock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than 1 liter per square meter (1 gallon per 50 square feet). A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.3.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled 12 mm (1/2 inch) from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding 12 mm (1/2 inch) from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below 4 degrees C (40 degrees F) the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of 0.73 kg per square meter (15 pound) dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than 150 mm (6 inches) in room areas and 75 mm (3 inches) above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top 25 mm (1 inch) of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it is to be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small amount of gravel or porous materials shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be clean (free of grease and grime). Sheets shall be laid on a flat surface with an overlap of about 50 mm (2 inches). Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces immediately placed together, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. In long lengths, about 600 or 900 mm (2 or 3 feet) at a time shall be welded. On wood subflooring, two layers of 0.73 kg per square meter (15 pound) felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

Mechanical equipment, including pumps, shall be isolated from the building structure by approved vibration-absorbing features, unless otherwise shown. Each foundation shall include an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to 30 percent of the lowest equipment rpm.

3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

3.6 IDENTIFICATION SYSTEMS

3.6.1 Identification Tags

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm (1-3/8 inch) inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.6.2 Pipe Color Code Marking

Color code marking of piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 12 mm (3/8 inch) in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 m (3 foot) width, 750 mm (30 inches) height, and 12 mm (1/2 inch) thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm (1/16 inch) transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm (3/4 inch) in diameter and the related lettering in 12 mm (1/2 inch) high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location
[]	[]	[]	[]

3.7 ESCUTCHEONS

Escutcheons shall be provided at finished surfaces where bare or insulated piping, exposed to view, passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons

shall be fastened securely to pipe or pipe covering and shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTING, GENERAL.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC Plumbing Code.

- a. Drainage and Vent Systems Tests.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.9.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on Testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Data of Gauges

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.9.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 25 mm (1 inch) for a period of 24 hours. Any drop in the water level during test, except for evaporation, will be reason for rejection, repair, and retest.

3.9.2 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately 1.2 meters per second (4 fps) through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall specify the number of fixtures to be operated during flushing. Contractor shall provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building due to the Contractor's failure to properly clean the piping system shall be repaired by the Contractor. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation. All faucets and drinking water fountains, to include any device considered as an end point device by NSF 61, Section 9, shall be flushed a minimum of 1 L (0.25 gallons) per 24 hour period, ten times over a 14 day period.

3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of each domestic hot-water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in

quadruplicate. The Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

3.9.5 Disinfection

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Water chlorination procedure shall be in accordance with AWWA M20. The chlorinating material shall be fed into the water piping system at a constant rate at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24-hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system including the tanks shall then be flushed with clean water until the residual chlorine level is reduced to less than one part per million. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA EWW. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.9.6 Flushing of Potable Water System

As an option to the system flushing specified above, the potable water system shall be flushed and conditioned until the residual level of lead is less than that specified by the base industrial hygienist. The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.10 PLUMBING FIXTURE SCHEDULE

3.10.1 Barracks Buildings and Soldier Community Buildings

P-1 WATER CLOSET (BARRACKS):

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M or wall mounted, as indicated. Floor flange shall be copper alloy or cast iron.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front. Lids shall be provided for barracks room module water closets.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters (1.6 gallons) per flush.

Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device. Ballcocks shall meet ASSE 1002.

Flush Valve in Flush Tank - Flush valve seats in tanks for flushing water closets shall be at least 25 mm (1 inch) above the flood level rim of the bowl connected thereto, except in approved water closet and flush tank combinations designed so that when the tank is flushed and the fixture is clogged or partially clogged, the flush valve shall close tightly so that water will not spill continuously over the rim of the bowl or back flow from the bowl to the tank.

P-1A WATER CLOSET HANDICAP ACCESSIBLE (SCB):

Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1.

P-2 Not Used

P-3 BATHROOM LAVATORY (BARRACKS):

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M, countertop, round or oval.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing pressure of 549 kPa (80) psi.

Drain - Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-3A WHEELCHAIR LAVATORY (SCB):

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 508.0 mm wide x 685.8 mm (20 inches wide x 27 inches) deep with gooseneck spout. Flow shall be limited to 1 liter (0.25 gallon) per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing water pressure of 549 kPa (80 psi).

Drain - Strainer shall be copper alloy or stainless steel.

P-4 NOT USED

P-5 KITCHEN SINK (Barracks):

Stainless steel per ASME A112.19.3M. Ledge back with holes for faucet and spout; single bowl

457.2 x 457.2 mm (18 x 18 inches).

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. Flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing water pressure of 549 kPa (80 psi).

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Stainless Steel per ASME A112.19.3M. Ledge back with holes for faucet and spout double bowl 812.8 x 533.4 mm (32 x 21 inches) with a food waste disposer.

Food Waste Disposers - shall be in accordance with UL 430.

P-6 MOP SINK:

Neo-Angle 812.8 mm x 812.8 mm with 406.4 mm dimension to the angled face (32 inches x 32 inches x 16 inches) 241.3 mm (9.5 inches) deep with reduced height at angled face, acid-resistant plastic IAPMO Z124.6. Thickness of sinks shall be manufacturer's standard. Drain shall be stainless steel.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

P-7 COMBINATION BATH/SHOWER (Barracks):

Bathtub: Straight front, recessed, 1.524 m X 812.8 mm X 406.4 mm (60 X 32 X 16 in), plastic, IAPMO Z124.1 without wall.

Shower: Shower heads, CID A-A-240 other than emergency showers, shall be adjustable spray type and shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) when tested in accordance with ASME A112.18.1M.

Wall Mounted: Showerhead shall be adjustable spray, stainless steel or chromium plated brass with ball joint. Handles shall be chrome-plated die cast zinc alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be thermostatic mixing pressure reducing type. Showerhead shall be vandal-proof with integral back.

Bath Showers: Bath showers shall include bathtub spout, showerhead, valves, and diverters. A showerhead mounting with ball joint shall be provided. Diverter shall be integral with single mixing valves or mounted hot and cold water valves. Tub spout shall be copper alloy.

P-8 Not Used

P-9 Not Used

P-10 LAUNDRY SINK (SCB Mud Room):

Fiberglass double bowl pedestal 1219 x 508.0 mm (48 x 20 inches) 48 x 20 inches.

Faucet and Spout - Cast copper alloy, wrought copper alloy, cast iron, or stainless steel, with backflow preventer. Faucets shall have replaceable seat and the stem shall rotate onto the seat. Strainers shall

have internal threads. Combination faucets shall be mounted on the tub back. Spouts shall be externally threaded for hose connection.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

Traps - Copper alloy, or cast iron.

P-11 Not Used

P-12 WATER COOLER DRINKING FOUNTAINS (SCB):

Drinking fountains shall meet the requirements of NSF 61, Section 9. Water cooler drinking fountains shall: be self contained, conform to ARI 1010, use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05, have a capacity to deliver 30.2 liters per hour (8 gph) of water at 10 degrees C (50 degrees F) with an inlet water temperature of 27 degrees C (80 degrees F) while residing in a room environment of 32 degrees C (90 degrees F), and have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide a flow of water at least 100 mm (4 inches) high so as to allow the insertion of a cup or glass under the flow of water.

Surface Wall-Mounted - Surface wall-mounted units shall be 336.6 mm (13-1/4 inches) wide, 330.2 mm (13 inches) deep, and have a back height of 152.4 to 203.2 mm (6 to 8 inches). The bowl shall be made of stainless steel. The unit shall have concealed fasteners and be for interior or exterior installation.

Semi-Recessed Wall-Mounted - Semi-recessed wall-mounted units shall be 355.6 mm (14 inches), 279.4 mm (11 inches) deep, and have a back height of 330.2 to 558.8 mm (13 to 22 inches). The bowl shall be made of stainless steel and be for interior or exterior installation as indicated.

Recessed Wall-Mounted - Recessed wall-mounted units shall be 425.5 mm (16-3/4 inches) wide, 279.4 mm (11 inches) deep, and have a back height 330.2 to 558.8 mm (13 to 22 inches). The bowl shall be made of stainless steel and be for interior or exterior installation as indicated.

P-12A WATER COOLER DRINKING FOUNTAINS, ACCESSIBLE (SCB):

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 381.0 mm (15 inches), 508.0 mm (20 inches) deep, with a back height of 152.4 to 203.2 mm (6 to 8 inches).. The unit shall clear the floor or ground by at least 200 mm (8 inches). A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm (27 inches) and between the front edge of the bowl and the body of the unit of at least 200 mm (8 inches). A 200 mm (8 inch) wide clear space shall exist on both sides of the unit. The spout height shall be no more than 1 m (36 inches) above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 165.1 mm (6-1/2 inches) high, made of stainless steel and be for interior or exterior installation as indicated.

3.10.2 MEDIUM BATTALION HEADQUARTERS AND COMPANY BUILDINGS

P-1 WATER CLOSET (BATTALION AND COMPANY BUILDINGS):

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, floor or wall mounted, as indicated. Floor flange shall be copper alloy or cast iron.

Gasket shall be wax type.

Seat - IAPMO Z124.5, Type A, white plastic, elongated, open front. Lids shall be provided for barracks room module water closets.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters (1.6 gallons) per flush.

Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device. Ballcocks shall meet ASSE 1002.

Flush Valve in Flush Tank - Flush valve seats in tanks for flushing water closets shall be at least 25 mm (1 inch) above the flood level rim of the bowl connected thereto, except in approved water closet and flush tank combinations designed so that when the tank is flushed and the fixture is clogged or partially clogged, the flush valve shall close tightly so that water will not spill continuously over the rim of the bowl or back flow from the bowl to the tank.

P-1A WATER CLOSET HANDICAP ACCESSIBLE (BATTALION AND COMPANY BUILDINGS):

Wall mounted with flush valve. Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1.

P-1B WATER CLOSET HANDICAP ACCESSIBLE (BATTALION AND COMPANY BUILDINGS):

Floor mounted flush tank. Height of top rim of bowl shall be in accordance with CABO A117.1; other features are the same as P-1.

P-2 URINAL (COMPANY/BATTALION BUILDINGS)

P-2 features and specifications are the same as that listed below for P-3

P-3 URINAL

Urinals shall be waterfree type which utilizes biodegradable liquid in a cartridge that floats on the water surface and seals the urine from the room atmosphere. The cartridge shall have a design duty life of 7,000 uses. Urinal shall be the wall hanging type with elongated bowl and extended shields.

P-2 URINAL HANDICAP ACCESSIBLE (BATTALION BUILDING ONLY)

Wall hanging, with integral trap and extended shields, ASME A112.19.2M siphon jet. Top supply connection, back outlet. Height of top rim of fixture shall be in accordance with CABO A117.1

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 3.8 liters 1 gallon per flush.

P-3A BATHROOM LAVATORY, Wall Hung (COMPANY BUILDINGS):

Manufacturer's standard sink depth, vitreous china ASME A112.19.2M round or oval with integral backsplash.

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing pressure of 549 kPa (80) psi.

Drain - Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece. See paragraph FIXTURES for optional plastic accessories.

P-3B LAVATORY HANDICAP ACCESSIBLE (COMPANY BUILDINGS ONLY):

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 508.0 mm wide x 685.8 mm (20 inches wide x 27 inches) deep with gooseneck spout. Flow shall be limited to 1 liter (0.25 gallon) per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing water pressure of 549 kPa (80 psi).

Drain - Strainer shall be copper alloy or stainless steel.

P-3D LAVATORY HANDICAP ACCESSIBLE (BATTALION BUILDING):

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 508.0 mm wide x 685.8 mm (20 inches wide x 27 inches) deep with gooseneck spout. Flow shall be limited to 1 liter (0.25 gallon) per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing water pressure of 549 kPa (80 psi).

Drain - Strainer shall be copper alloy or stainless steel.

P-4 MOP SINK (BATTALION AND COMPANY BUILDINGS):

Neo-Angle 812.8 mm x 812.8 mm with 406.44 mm dimension to the angled face (32 inches x 32 inches x 16 inches) 241.3 mm (9.5 inches) deep with reduced height at angled face, acid-resistant plastic IAPMO Z124.6. Thickness of sinks shall be manufacturer's standard. Drain shall be stainless steel.

Faucet and Spout - Cast or wrought copper alloy, with top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

P-5 DRINKING FOUNTAINS (BATTALION AND COMPANY BUILDINGS) [DF-1 at Battalion]:

Drinking fountains shall meet the requirements of NSF 61, Section 9. Drinking fountains shall have self-closing valves. Self-closing valves shall have automatic stream regulators, have a flow control capability, have a push button actuation or have a cross-shaped index metal turn handle without a hood. Exposed surfaces of stainless steel shall have No. 4 general polish finish. Spouts shall provide

a flow of water at least 100 mm (4 inches) high so as to allow the insertion of a cup or glass under the flow of water.

Handicapped - Handicapped units shall be surface wall-mounted. The dimensions shall be 381.0 mm (15 inches), 508.0 mm (20 inches) deep, with a back height of 152.4 to 203.2 mm (6 to 8 inches).. The unit shall clear the floor or ground by at least 200 mm (8 inches). A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm (27 inches) and between the front edge of the bowl and the body of the unit of at least 200 mm (8 inches). A 200 mm (8 inch) wide clear space shall exist on both sides of the unit. The spout height shall be no more than 1 m (36 inches) above the floor or ground to the outlet. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl shall be 165.1 mm (6-1/2 inches) high, made of stainless steel and be for interior or exterior installation as indicated.

P-6 SHOWER (BATTALION AND COMPANY BUILDINGS):

Shower: Shower heads, CID A-A-240 other than emergency showers, shall be adjustable spray type and shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) when tested in accordance with ASME A112.18.1M.

Wall Mounted: Showerhead shall be adjustable spray, stainless steel or chromium plated brass with ball joint. Handles shall be chrome-plated die cast zinc alloy. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be thermostatic mixing pressure reducing type. Showerhead shall be vandal-proof with integral back.

Drain: Similar to Floor Drain, but with round stainless steel grid.

P-7 Not Used

P-8 Not Used

P-9 Not Used

P-10 Not Used

P-11 Not Used

P-12 SINK (BATTALION AND COMPANY BUILDINGS):

Manufacturer's standard sink depth, single compartment 18 gauge Type 302 stainless steel, approximately 558mm left to right, 558mm front to back, 190mm deep.

Deck mount faucet, gooseneck type with swing spout - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be single control, mixing type. Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools. Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa (80 psi) if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second (2.5 gpm) at a flowing pressure of 549 kPa (80) psi.

Drain - Perforated stainless steel grid strainer with stainless steel tailpiece and cast brass p-trap and cleanout.

P-13 EQUIPMENT WASH SINK (COMPANY BUILDINGS)

Sink: Custom built scullery type sink, floor mounted, triple compartment with drain board. Shall be 16 gauge Type 304 stainless steel. Provide with 44mm radius coved corner compartments and 203mm high x 50mm deep sanitary backsplash with 45° slope top. Provide with 41mm OD legs having adjustable bullet feet. Provide with basket strainer type drain.

Faucet: Polished chrome plate finish faucet with adjustable centers and 203mm swing spout having integral vacuum breaker. Provide with 64mm metal lever handles for hot and cold water. Provide two faucets per sink.

Refer to drawings for construction details.

P-14 LAVATORY (BATTALION BUILDING)

Features same as P-12, except 483mm left to right, 483mm front to back.

3.11 POSTED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C (70 degrees F) delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/0.093 sq. m. (W/sq. ft.) based on 27 degrees C (80 degrees F) delta T, or in percent per hour based on nominal 38 degrees C (90 degrees F) delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

3.12.1 Storage Water Heaters

3.12.1.1 Electric

- a. Storage capacity of 454 liters (120 gallons) or less, and input rating of 12 kW or less:
minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.
- b. Storage capacity of more than 454 liters (120 gallons) or input rating more than 12 kW:
maximum SL shall be 1.9 w/0.093 sq. m. 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

3.12.1.2 Gas

- a. Storage capacity of 379 liters (100 gallons) or less, and input rating of 21980 W 75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 379 liters (100 gallons) - or input rating more than 21980 W: 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter (6.5 Btu/h/sq. ft).

3.12.3 Instantaneous Water Heater

3.12.3.1 Gas

Volumes and inputs: ET shall be 80 percent per ANSI Z21.10.3.

3.13 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets	X	X	X	X	X	
2	Cast iron soil pipe and fittings hubless, CISPI 301 and ASTM A 888		X		X		
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		X	X	
6	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M for use with Item 5	X	X		X	X	
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75M ASTM B 75 C12200, ASTM B 152, ASTM B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43		X	X			

12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42				X		
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760	X	X	X	X	X	X
21	Process glass pipe and fittings, ASTM C 1053						X
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

SERVICE:

- A - Underground Building Soil, Waste and Storm Drain
- B - Aboveground Soil, Waste, Drain In Buildings
- C - Underground Vent
- D - Aboveground Vent
- E - Interior Rainwater Conductors Aboveground
- F - Corrosive Waste And Vent Above And Belowground
- * - Hard Temper

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE		
		A	B	C
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a b. Same as "a" but not galvanized for use with Item 4b	X	X	X
2	Grooved pipe couplings, ferrous pipe ASTM A 536 and ASTM A 47/A 47M, non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M,	X	X	
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A 536 and ASTM A 47/A 47M, for use with Item 2	X	X	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B	X	X	X
5	Seamless red brass pipe, ASTM B 43	X	X	X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X	X
7	Seamless copper pipe, ASTM B 42	X	X	X
8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X	X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5 and 7	X	X	X

11	Cast copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 8 and 9	X	X	X
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15			X
18	Polyethylene (PE) plastic tubing, ASTM D 2737	X*		X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X*		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X*		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X*		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F 437, for use with Items 20, and 21	X*		X

23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X*	X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X*	X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X*	X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X*	X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X*	X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X*	X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X*	X
30	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X*	X
31	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996		
32	Steel pipeline flanges, MSS SP-44		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83		
35	Malleable-iron threaded pipe unions ASME B16.39		
36	Nipples, pipe threaded ASTM A 733		

37 Crosslinked Polyethylene (PEX) X
Plastic Pipe ASTM F 877.

A - Cold Water Aboveground

B - Hot Water 82 degree C 180 degrees F Maximum Aboveground

C - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

* - Cold water piping to water closets only

** - Type L - Hard

*** - Type K - Hard temper with brazed joints only or type K-soft temper
without joints in or under floors

**** - In or under slab floors only brazed joints

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	454 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	454 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/0.09 sq. m. maximum
Gas	380 max.		22 kW max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	380 min.	OR	22 kW min.	ANSI Z21.10.3	ET= 77 percent; SL = 1.3+38/V max.
Oil	190 max.		30.8 kW	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	190 min.	OR	30.8 kW	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, Instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter

C. Instantaneous Water Heater

Gas	All	All	ANSI Z21.10.3	ET = 80 percent
Oil	All	All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	ANSI Z21.56	ET = 78 percent
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TERMS:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0
(trace is permitted).

SL = Standby loss in W/0.09 sq. m. based on 27 degrees C delta T, or in
percent per hour based on nominal 32 degrees C delta T.

HL = Heat loss of tank surface area

V = Storage volume in gallons

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	120 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.		75,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	100 min.	OR	75,000 Btu/h	ANSI Z21.10.3	ET = 77 percent; SL = 1.3+38/V max.
Oil	50 max.		105,000 Btu/h	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	51 min.	OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

C. Instantaneous Water Heater

Gas	All		All	ANSI Z21.10.3	ET = 80 percent
Oil	All		All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All		All	ANSI Z21.56	ET = 78 percent
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TERMS:

EF = Energy factor, overall efficiency.
ET = Thermal efficiency with 70 degrees F delta T.
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0
(trace is permitted).
SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in
percent per hour based on nominal 90 degrees F delta T.
HL = Heat loss of tank surface area
V = Storage volume in gallons

END OF SECTION

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SECTION 15569

WATER HEATING; GAS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 801 (1992) Industrial Process/Power Generation Fans:
Specification Guidelines

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.13 (1991; Z21.13a; Z21.13b) Gas-Fired Low-Pressure Steam
and Hot Water Boilers

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 53/A 53M (1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated,
Welded and Seamless

ASTM A 105/A 105M (1998) Carbon Steel Forgings for Piping Applications

ASTM A 167 (1999) Stainless and Heat-Resisting Chromium-Nickel Steel
Plate, Sheet, and Strip

ASTM A 183 (1983; R 1998) Carbon Steel Track Bolts and Nuts

ASTM A 193/A 193M (1999a) Alloy-Steel and Stainless Steel Bolting Materials for
High-Temperature Service

ASTM A 234/A 234M (1999) Piping Fittings of Wrought Carbon Steel and Alloy
Steel for Moderate and High Temperature Services

ASTM A 366/A 366M (1997e1) Steel, Sheet, Carbon, Cold-Rolled, Commercial
Quality

ASTM A 515/A 515M (1989; R 1997) Pressure Vessel Plates, Carbon Steel, for
Intermediate- and Higher-Temperature Service

ASTM A 516/A 516M (1990; R 1996) Pressure Vessel Plates, Carbon Steel, for
Moderate- and Lower-Temperature Service

ASTM A 536 (1984; R 1999e1) Ductile Iron Castings

ASTM A 653/A 653M (1999a) Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron
Alloy-Coated (Galvannealed) by the Hot-Dip Process

ASTM B 32	(1996) Solder Metal
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications of Copper and Copper Alloy Tube
ASTM B 828	(1998) Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM C 27	(1998) Fireclay and High-Alumina Refractory Brick
ASTM C 34	(1996) Structural Clay Load-Bearing Wall Tile
ASTM C 155	(1997) Standard Classification of Insulating Firebrick
ASTM C 401	(1991; R 1995e1) Alumina and Alumina-Silicate Castable Refractories
ASTM D 596	(1991; R 1995) Reporting Results of Analysis of Water
ASTM D 1784	(1999a) Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM F 872	(1984; R 1990) Filter Units, Air Conditioning: Viscous-Impingement Type, Cleanable
ASTM F 876	(1999a) Crosslinked Polyethylene (PEX) Tubing
ASTM F 1097	(1991; R 1996) Mortar, Refractory (High-Temperature, Air-Setting)
ASTM F 1139	(1988; R 1998) Standard Specification for Steam Traps and Drains

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24

ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.34	(1997) Valves - Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B19.3	(1991; B19.3a; B19.3b) Safety Standard for Compressors for Process Industries
ASME B31.1	(1998) Power Piping
ASME B31.5	(1992; B31.5a1994) Refrigeration Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IV	(1998) Boiler and Pressure Vessel Code; Section IV, Heating Boilers
ASME BPV VIII Div 1	(1998) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME CSD-1	(1998) Controls and Safety Devices for Automatically Fired Boilers
ASME PTC 10	(1997) Compressors and Exhausters

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints
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AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D; Canc. Notice 1) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)
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COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA Tube Handbook	(1995) Copper Tube Handbook
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EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(1998; 7th Edition) EJMA Standards
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HYDRONICS INSTITUTE DIVISION OF GAMA (HYI)

HYI-01	(1998) I=B=R Ratings for Boilers, Baseboard Radiation and Finned Tube (Commercial) Radiation
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HYI-400	(1998) I=B=R Product Floor Heating
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
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MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
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MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
-----------	---

MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
-----------	---

MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanges and Threaded Ends
-----------	---

MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
-----------	---

MSS SP-73	(1991; R 1996) Brazing Joints for Copper and Copper Alloy Pressure Fittings
-----------	--

MSS SP-78	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
-----------	---

MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
-----------	---

MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
-----------	---

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1997) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(1997 TIA 97-1) Installation of Oil Burning Equipment
NFPA 54	(1999) National Fuel Gas Code
NFPA 70	(1999) National Electrical Code
NFPA 211	(2000) Chimneys, Fireplaces, Vents, and Solid Fuel-Burning Appliances
NFPA 8501	(1997) Single Burner Boiler Operation

UNDERWRITERS LABORATORIES (UL)

UL 296	(1994; Rev Sep 1998) Oil Burners
UL 726	(1995; Rev through Jan 1999) Oil-Fired Boiler Assemblies
UL 795	(1999) Commercial-Industrial Gas Heating Equipment
UL 1738	(1993; Rev through Mar 1998) Venting Systems for Gas-Burning Appliances, Categories II, III and IV
UL Gas & Oil Dir	(1999) Gas and Oil Equipment Directory

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Heating System; G
Piping Installation; G
Installation; G

Detail drawings consisting of equipment layout including installation details and electrical connection diagrams; combustion and safety control diagrams; ductwork layout showing the location of supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of guides and anchors, thermal expansion loops, seismic joints, flexible pipe connectors, the load imposed on each support or anchor (not required for radiant floor tubing), and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

Complete calculations shall be submitted for all thermal expansion and seismic joints. Calculations shall be performed by a licensed engineer. See specification Section 15070 Seismic Protection For Mechanical Equipment.

SD-03 Product Data

Manufacturer's Catalog Data; G

Manufacturer's catalog data shall be included with the detail drawings for the following items:

Boilers
Fuel Burning Equipment
Combustion Control Equipment
Pumps
Fittings and Accessories
Water Treatment System

The data shall show model, size, options, etc., that are intended for consideration. Data submitted shall be adequate to demonstrate compliance with contract requirements.

Spare Parts Data;

Spare parts data for each different item of material and equipment, after approval of the detail drawings and no later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of the parts recommended by the manufacturer to be replaced after 1 and 3 years of service.

Water Treatment Plan; Boiler Water Treatment;

Three complete copies of the proposed water treatment plan. The plan shall include a layout, control scheme, a list of the existing water conditions including the items listed in paragraph BOILER WATER TREATMENT, a list of all chemicals, the proportion of chemicals to be added, the final treated water conditions, and a description of environmental concerns for handling the chemicals.

Heating System Tests; G Fuel System Tests; G

Proposed test procedures for the heating system tests and fuel system tests, at least 2 weeks prior to the start of related testing.

Welding;

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Qualification;

A statement from the firms proposed to prepare submittals and perform installation and testing, demonstrating successful completion of similar services of at least five projects of

similar size or scope, at least 2 weeks prior to the submittal of any other item required by this section.

Field Instructions; G

System layout diagrams that show the layout of equipment, piping, and ductwork and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system, framed under glass or laminated plastic, at least 2 weeks prior to the start of related testing. After approval, these items shall be posted where directed.

Tests;

Proposed test schedules for the heating system and fuel system tests, at least 2 weeks prior to the start of related testing.

SD-06 Test Reports

Heating System Tests; G

Fuel System Tests; G

Test reports for the heating system tests and the fuel system test, upon completion of testing complete with results.

Water Treatment Tests;

.....a. The water quality test report shall identify the chemical composition of the boiler water. The report shall include a comparison of the condition of the boiler water with the manufacturer's recommended conditions. Any required corrective action shall be documented within the report.

b. A test report shall identify the condition of the boiler at the completion of 1 year of service. The report shall include a comparison of the condition of the boiler with the manufacturer's recommended operating conditions.

SD-07 Certificates

Bolts;

Written certification by the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, the date of manufacture, and the number of each type of bolt to be furnished based on this certification.

SD-10 Operation and Maintenance Data

Heating System; G

Six complete manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, simplified wiring and control diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization shall be capable of providing 8 hour onsite response to a service call on an emergency basis.

Water Treatment System;

Six complete copies of operating and maintenance manuals for the step-by-step water treatment procedures, including procedures for testing the water quality.

1.3 GENERAL REQUIREMENTS

1.3.1 Standard Products

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Equipment shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

1.3.2 Asbestos Prohibition

Asbestos and asbestos-containing products shall not be used.

1.3.3 Nameplates

Each major component of equipment shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a plate secured to the equipment. Each pressure vessel shall have an approved ASME stamp. A unique identifier shall be mounted on the equipment to be reflected in the shop drawings.

1.3.4 Equipment Guards

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded in accordance with OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed in accordance with Section 05500 MISCELLANEOUS METAL.

1.3.5 Verification of Dimensions

The Contractor shall become familiar with details of the work, verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work or ordering any materials.

1.3.6 Welding

Boilers and piping shall be welded and brazed in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with ASME BPV IX. Welding procedures qualified by others, and welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practical. The welder or welding operator shall apply his assigned symbol near each weld he makes as a permanent record. Structural members shall be welded in accordance with Section 05090 WELDING, STRUCTURAL

1.4 MANUFACTURER'S SERVICES

Services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified shall be provided. The representative shall supervise the installing, adjusting, and testing of the equipment.

1.5 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be protected from the weather, humidity and temperature variations, dirt and dust, and other contaminants.

PART 2 PRODUCTS

2.1 BOILERS

Each boiler shall have the output capacity in kilowatts (kW)/British thermal units per hour (Btuh) as indicated when fired with the specified fuels. The boiler shall be furnished complete with the gas burning equipment, boiler fittings and trim, automatic controls, forced draft fan, electrical wiring, insulation, piping connections, and protective jacket. The boiler shall be completely assembled and tested at the manufacturer's plant. Boiler auxiliaries including fans, motors, drives, and similar equipment shall be provided with at least 10 percent excess capacity to allow for field variations in settings and to compensate for any unforeseen increases in pressure losses in appurtenant piping and ductwork. However, the boiler safety devices shall not be sized for a 10 percent excess capacity. The boiler and its accessories shall be designed and installed to permit ready accessibility for operation, maintenance, and service. Boilers shall be designed, constructed, and equipped in accordance with ASME BPV IV. Each boiler shall be of the firetube or watertube type as indicated and designed for water service as specified herein. The boiler capacity shall be based on the ratings shown in HYI-01 or as certified by the American Boiler Manufacturers Association, or American Gas Association. Boilers shall have a minimum 406 mm diameter rear access door to the combustion chamber without removal of the burner.

2.1.1 Firetube Boiler

Boiler shall be self-contained steel horizontal, 3pass or greater, wet backed firebox or scotch marine, packaged type, complete with all accessories, mounted on a structural steel base. When the boilers are operating at maximum output, the heat output rates shall not be greater than 21 kW per square meter (6,700 Btu/hr per square ft) of fireside heating surface.

2.1.2 Watertube Boiler

The boiler shall be a bent or flexible type of water tube boiler. Boiler shall be self-contained, packaged type, complete with all accessories, mounted on a structural steel base. The boiler heating surface area for bent or flexible tube boilers shall be at least 0.03 square meters per kW (4 square feet per boiler horse power). The tubes for bent or flexible tube boilers shall be designed for replacement without requiring welding or rolling of tubes. Any special tools required for bent or flexible tube removal or installation shall be provided with the boiler.

2.1.4 Hot Water Heating Boilers

The hot water heating boiler shall be capable of operating at the specified maximum continuous capacity without damage or deterioration to the boiler, its setting, firing equipment, or auxiliaries. The rated capacity shall be the capacity at which the boiler will operate continuously while maintaining at least the specified minimum efficiency. The boiler design conditions shall be as indicated. General operating conditions are as follows:

- a. Outdoor ambient air temperature 30 degrees C (86 degrees F (max), -7 degrees C (19 degrees F) (min).
- b. Site elevation 92 m (301 feet).

- c. Boilers with a capacity less than 90 kW (300,000 Btuh) shall have an Annual Fuel Utilization Efficiency of at least 83 percent. Gas fired boilers with a capacity of greater than or equal to 90 kW (300,000 Btuh) shall have a thermal efficiency of at least 83 percent when fired at the maximum and minimum ratings allowed by the controls.

2.2 FUEL BURNING EQUIPMENT

Boilers shall be designed to burn gas. Each boiler shall comply with Federal, state, and local emission regulations.

2.2.1 Burners

2.2.1.1 Gas Fired Burners and Controls

Burners shall be UL approved mechanical draft burners with all air necessary for combustion supplied by a blower where the operation is coordinated with the burner. Burner shall be provided complete with fuel supply system in conformance with the following safety codes or standards:

- a. Gas-fired units with inputs greater than 1.17 MW (400,000 Btuh) per combustion chamber shall conform to UL 795. Gas fired units less than 3.66 MW (12,500,000 Btuh) input shall conform to ANSI Z21.13.

2.2.2 Draft Fans

Fans conforming to AMCA 801 forced-draft shall be furnished as an integral part of boiler design. Fans shall be centrifugal with backward-curved or radial-tip blades. Each fan shall be sized for output volume and static pressure rating sufficient for pressure losses, excess air requirements at the burner, leakages, temperature, and elevation corrections for worst ambient conditions, all at full combustion to meet net-rated output at normal firing conditions, plus an overall excess air volume of 10 percent against a 20 percent static overpressure. Noise levels for fans shall not exceed 85 decibels in any octave band at a .914 meters (3 foot).

2.2.2.1 Draft Fan Control

Forced-draft centrifugal fans shall have inlet vane controls or shall have variable speed control where indicated. Inlet vanes shall be suitable for use with combustion control equipment

2.2.2.2 Draft Fan Drives

Fans shall be driven by electric motors. Electric motor shall be open drip proof, . Motor starter shall be magnetic across-the-line type with general purpose enclosure and shall be furnished with four auxiliary interlock contacts.

2.2.3 Draft Damper

Boilers shall be provided with manual or automatic dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler. Draft damper shall be provided in a convenient and accessible location in the flue gas outlet from the boiler. Automatic damper shall be arranged for automatic operation by suitable means.

2.2.4 Ductwork

Air ducts connecting the forced-draft fan units with the plenum chamber shall be designed to convey air with a minimum of pressure loss due to friction. Ductwork shall be galvanized sheet metal conforming to ASTM A 653/A 653M. Ducts shall be straight and smooth on the inside with laps made in direction of air flow. Ducts shall have cross-break with enough center height to assure rigidity in the duct

section, shall be angle iron braced, and shall be completely free of vibration. Access and inspection doors shall be provided as indicated and required, with a minimum of one in each section between dampers or items of equipment. Ducts shall be constructed with long radius elbows having a centerline radius 1-1/2 times the duct width, or where the space does not permit the use of long radius elbows, short radius or square elbows with factory-fabricated turning vanes may be used. Duct joints shall be substantially airtight and shall have adequate strength for the service, with 38 x 38 x 3 mm (1-1/2 x 1-1/2 x 1/8 inch) angles used where required for strength or rigidity. Duct wall thickness shall be 16 gauge (1.5 mm, 0.0598 inch) for ducts 1500 mm (60 inches) or less and 12 gauge (2.66 mm, 0.1046 inch) for ducts larger than 1500 mm (60 inches) in maximum dimension. Additional ductwork shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.3 COMBUSTION CONTROL EQUIPMENT

Combustion control equipment shall be provided as a system by a single manufacturer. Field installed automatic combustion control system shall be installed in accordance with the manufacturer's recommendations and under the direct supervision of a representative of the control manufacturer. The boiler water temperature shall be controlled by a water temperature controller. The equipment shall operate either. On multiple boiler installations, each boiler unit shall have a completely independent system of controls responding to the load and to a plant master controller.

2.3.1 Electrical controls

Electrical control devices shall be rated at 120 or 24 volts as required and shall be connected as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

2.3.2 Water Temperature Controller

The controller shall be of sturdy construction and shall be protected against dust and dampness. The thermostatic element shall be inserted in a separable socket installed in the upper part of the boiler near the water outlet, or in the boiler outlet piping as recommended by the manufacturer. Fixed position (on-off) and three position (high-low-off) controller shall operate on a 5.56 degree C (10 degree F) differential over an adjustable temperature range of approximately 60 to 104.4 degrees C (140 to 220 degrees F). Modulating controllers shall control the fuel burning equipment to maintain set boiler water temperature within 2 percent. A separate controller shall be furnished with necessary equipment to automatically adjust the building loop temperature setting to suit the outside weather conditions in accordance with the loop temperature reset schedule indicated. The outside air reset controller shall be operated in such a manner that the operating temperatures required by the boiler manufacturer are not compromised.

2.3.3 Boiler Plant Master Controller

Where two boilers are indicated to operate in parallel, a boiler plant master controller shall be furnished to provide anticipatory or interlock signals to all boiler controllers. Boiler controllers shall react to anticipatory signals from the plant master controller as necessary in response to the individual and mixed boiler outlet temperatures to maintain the preset boiler outlet temperatures as well as meeting the building loop temperature reset schedules. An automatic-manual switch shall be provided to allow the sequence of boiler loading to be varied to distribute equal firing time on all boilers in the plant. The plant master controller shall load the boilers one at a time as the plant load increases.

2.3.4 Boiler Combustion Controls and Positioners

- a. Gas boiler units shall be provided with fixed rate (on-off), three position (high-low-off), or modulating combustion controls with gas pilot or spark ignition. Modulating controls shall be provided with a means for manually controlling the firing rate.

- b. Modulating control function shall be accomplished using positioning type controls. Air flow ratio and fuel control valve shall be controlled by relative positions of operative levers on a jackshaft responding to a water temperature controller. Positioning type combustion control equipment shall include draft controls with synchronized fuel feed and combustion air supply controls, which shall maintain the proper air/fuel ratio. The desired furnace draft shall be maintained within 2.5 Pa (0.01) inch of water column.
- d. Fixed rate on-off and High-low-off controls for boilers with capacities up to 600 kW (2,000,000 Btuh) shall use a water temperature controller in a temperature well in direct contact with the water.

2.3.5 Combustion Safety Controls and Equipment

Combustion safety controls and equipment shall be UL or IRI listed. The system shall include microprocessor-based distributed process controller, mounting hardware, wiring and cables, and associated equipment. The controller shall be mounted completely wired, programmed, debugged, and tested to perform all of its functions. The controller shall process the signals for complete control and monitoring of the boiler. This shall include maintaining boiler status, starting and stopping all control functions, sequencing control functions and signaling alarm conditions. The program shall be documented and include cross references in description of coils and contacts. Microprocessor shall be able to perform self diagnostics and contain a message center to provide operator with status and failure mode information. Controllers for each boiler shall be mounted on a separate, free standing panel adjacent to the boiler or for packaged boilers on the boiler supporting structure. Control systems and safety devices for automatically fired boilers shall conform to ASME CSD-1. Separate dedicated boiler circuits shall be provided with emergency shutoff switches located adjacent to the boiler room exit door. Electrical combustion and safety controls shall be rated at 120 volts, single phase, 60 Hz and shall be connected as specified in Section 16415 ELECTRICAL WORK, INTERIOR. A 100 mm (4 inch) diameter alarm bell shall be provided and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure, and a green light shall indicate that the main fuel valve is open. The following shutdown conditions shall require a manual reset before the boiler can automatically recycle:

- a. Flame failure.
- b. Failure to establish pilot flame.
- c. Failure to establish main flame.
- d. Low-water cutoff.
- e. High temperature cutoff.

2.3.5.1 Low-water Cutoff

Low water cutoff shall be float actuated switch or electrically actuated probe type low-water cutoff. Float chamber shall be provided with a blow-down connection. Cutoff shall cause a safety shutdown and sound an alarm when the boiler water level drops below a safe minimum level. A safety shutdown due to low water shall require manual reset before operation can be resumed and shall prevent recycling of the burner. The cutoff shall be in strict accordance to the latest version of code, ASME CSD-1 Controls and Safety Devices for Automatically Fired Boilers.

2.3.5.2 Water Flow Interlock

Hot water boiler limit controls shall be provided to include protection for low boiler water flow and high boiler water temperature. The limit controls shall be interlocked with the combustion control system to

effect boiler alarm and shutdown. The controls shall not allow boiler startup unless hot water flow is proven.

2.4 PUMPS

2.4.2 Hot Water and Boiler Circulating Pumps

Circulating pumps for hot water shall be electrically driven single-stage centrifugal type and have a capacity not less than indicated. Boiler circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base or by the piping on which installed and shall be closed-coupled shaft or flexible-coupled shaft. The boiler circulating pumps shall be horizontal or vertical split case. Hot water circulating pumps shall be supported on a concrete foundation with a cast iron or structural steel base and shall have a closed-coupled shaft or flexible-coupled shaft. The hot water circulating pumps shall be horizontal or vertical split case type. The pump shaft shall be constructed of corrosion-resistant alloy steel, sleeve bearings and glands of bronze designed to accommodate a mechanical seal, and the housing of close-grained cast iron. Pump seals shall be capable of withstanding 115 degrees C (240 degrees F) temperature without external cooling. The motor shall have sufficient power for the service required, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements of paragraph ELECTRICAL EQUIPMENT. Each pump suction and discharge connection shall be provided with a pressure gauge as specified. The boiler and building loop hot water circulating pump discharge headers shall be provided with flow or pressure switches. Flow switch unit shall be a self-contained swinging vane type to indicate fluid flow, and pressure switch unit shall be a self-contained snap action type to indicate fluid pressure. Switch shall be a SPDT with 120-volt, 15-ampere rating.

2.5 COLD WATER CONNECTIONS

Connections shall be provided which includes consecutively in line a strainer, backflow prevention device, and water pressure regulator in that order in the direction of the flow. The backflow prevention device shall be provided as indicated and in compliance with Section 15400, PLUMBING, GENERAL PURPOSE. Cold water fill connections shall be made to the water supply system as indicated. Necessary pipe, fittings, and valves required for water connections between the boiler and cold water main shall be provided as shown. The pressure regulating valve shall be of a type that will not stick or allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately 35 kPa (5 psi) in excess of the static head on the system and shall operate within a 15 kPa (2 psi) tolerance regardless of cold water supply piping pressure and without objectionable noise under any condition of operation.

2.6 RADIATORS AND CONVECTORS

Radiators, convectors and associated equipment shall be in accordance with Section 15556 FORCED HOT WATER HEATING SYSTEMS USING WATER AND STEAM HEAT EXCHANGERS.

2.7 HEATING AND VENTILATING UNITS

Heating and ventilating units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.8 AIR HANDLING UNITS

Air handling units and associated equipment shall be in accordance with Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM.

2.9 FITTINGS AND ACCESSORIES

Boiler fittings and accessories shall be installed with each boiler in accordance with ASME BPV IV, unless otherwise specified.

2.9.1 Conventional Breeching and Stacks

2.9.1.1 Breeching

Each boiler shall be connected to the stack or flue by breeching constructed of black steel sheets not less than 1.2 mm (0.0478 inch) thick nor less than thickness of stack, whichever is larger. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. The clear distance between any portion of the breeching surface and any combustible material shall not be less than that specified in NFPA 211. Joints and seams shall be securely fastened and made airtight. Suitable hinged and gasketed cleanouts shall be provided, which will permit cleaning the entire smoke connection without dismantling. Flexible-type expansion joints shall be provided as required and shall not require packing.

2.9.1.2 Stacks

Individual or grouped stacks shall extend above the roof to heights required by NFPA 54, or as indicated. Stack section shall be sheet steel having a thickness of not less than 2.47 mm (0.0972 inch). Prefabricated double wall stacks system shall extend above the roof to heights required by NFPA 54, or as indicated. The inner stack shall be 304 or 316 stainless steel having a thickness of not less than 0.89 mm (0.035 inch). The outer stack shall be sheet steel having a thickness of not less than 0.635 mm (0.025 inch). A method of maintaining concentricity between the inner and outer stacks shall be incorporated. The joints between the stack sections shall be sealed to prevent flue gas leakage. A 7.92 mm (0.3125 inch) diameter hole shall be provided in the stack not greater than 150 mm (6 inches) from the furnace flue outlet for sampling of the exit gases. A method shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each stack shall be provided complete with rain hood. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases.

2.9.2 Direct Vents

Direct venting shall be used as recommended by the manufacturer. Both the air intake and exhaust vents shall be located as indicated on the drawings and sized as recommended by the boiler manufacturer. A separate combustion air intake vent and exhaust vent shall be provided for each boiler.

2.9.2.1 Combustion Air Intake Vent

The combustion air intake piping shall be constructed of Schedule 40 PVC per ASTM D 1784 or with 22 gauge sheet metal galvanized duct as called for on the drawings. The vent shall be suitable for the temperature at the boiler combustion air intake connection point. Each intake shall be provided complete with bird screen.

2.9.2.2 Exhaust Vent

The exhaust vent piping shall be constructed of Schedule 40 CPVC or stainless steel conforming to UL 1738 and the boiler manufacturer's recommendations. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. The exhaust vent shall be suitable for the maximum anticipated boiler exhaust temperature and shall withstand the corrosive effects of the condensate. A 8 mm (0.3125 inch) diameter hole shall be provided in the stack not greater than 152 mm (6 inches) from the boiler flue outlet for sampling of the exit gases. A method

shall be provided to seal the hole to prevent exhaust gases from entering the boiler room when samples are not being taken. Each exhaust stack shall be provided complete with bird screen.

2.9.3 Expansion Tank

The hot water pressurization system shall include a diaphragm-type expansion tank which will accommodate the expanded water of the system generated within the normal operating temperature range, limiting the pressure increase at all components in the system to the maximum allowable pressure at those components. The only air in the system shall be the permanent sealed-in air cushion contained in the diaphragm-type tank. The sizes shall be as indicated. The expansion tank shall be welded steel, constructed, tested, and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 850 kPa (125 psi) and precharged to the minimum operating pressure. The tank's air chamber shall be fitted with an air charging valve and pressure gauge. The tank shall be supported by steel legs or bases for vertical installation or steel saddles for horizontal installations. The tank shall have lifting rings and a drain connection. All components shall be suitable for a maximum operating temperature of 120 degrees C (250 degrees F).

2.9.4 Air Separator

External air separation tank shall be steel, constructed, tested and stamped in accordance with ASME BPV VIII Div 1 for a working pressure of 850 kPa (125 psi). The capacity of the air separation tanks indicated is minimum.

2.9.5 Filters

Filters shall conform to ASTM F 872 and CID A-A-1419, as applicable.

2.9.6 Steel Sheets

2.9.6.1 Galvanized Steel

Galvanized steel shall be ASTM A 653/A 653M.

2.9.6.2 Uncoated Steel

Uncoated steel shall be ASTM A 366/A 366M, composition, condition, and finish best suited to the intended use. Gauge numbers specified refer to manufacturer's standard gauge.

2.9.7 Gaskets

Gaskets shall be nonasbestos material in accordance with ASME B16.21, full face or self-centering type. The gaskets shall be of the spiral wound type with graphite filler material.

2.9.8 Steel Pipe and Fittings

2.9.8.1 Steel Pipe

Steel pipe shall be ASTM A 53/A 53M, Type E or S, Grade A or B, black steel, standard weight.

2.9.8.2 Steel Pipe Fittings

Fittings shall have the manufacturer's trademark affixed in accordance with MSS SP-25 so as to permanently identify the manufacturer.

2.9.8.3 Steel Flanges

Flanged fittings including flanges, bolts, nuts, bolt patterns, etc. shall be in accordance with ASME B16.5 class 150 and shall have the manufacturers trademark affixed in accordance with MSS SP-25. Flange material shall conform to ASTM A 105/A 105M. Flanges for high temperature water systems shall be serrated or raised-face type. Blind flange material shall conform to ASTM A 516/A 516M cold service and ASTM A 515/A 515M for hot service. Bolts shall be high strength or intermediate strength with material conforming to ASTM A 193/A 193M.

2.9.8.4 Welded Fittings

Welded fittings shall conform to ASTM A 234/A 234M with WPA marking. Buttwelded fittings shall conform to ASME B16.9, and socket-welded fittings shall conform to ASME B16.11.

2.9.8.5 Cast-Iron Fittings

Fittings shall be ASME B16.4, Class 125, type required to match connecting piping.

2.9.8.6 Malleable-Iron Fittings

Fittings shall be ASME B16.3, type as required to match connecting piping.

2.9.8.7 Unions

Unions shall be ASME B16.39, Class 150.

2.9.8.8 Threads

Pipe threads shall conform to ASME B1.20.1.

2.9.8.9 Grooved Mechanical fittings

Joints and fittings shall be designed for not less than 862 kPa (125 psig) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 for circulating medium up to 110 degrees C (230 degrees F). Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.9.9 Copper Tubing and Fittings

2.9.9.1 Copper Tubing

Tubing shall be ASTM B 88, ASTM B 88M, Type K or L. Adapters for copper tubing shall be brass or bronze for brazed fittings.

2.9.9.2 Solder-Joint Pressure Fittings

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M (ASTM B 75). Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18 and ASTM B 828.

2.9.9.3 Flared Fittings

Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62.

2.9.9.4 Adapters

Adapters may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.9.9.5 Threaded Fittings

Cast bronze threaded fittings shall conform to ASME B16.15.

2.9.9.6 Brazing Material

Brazing material shall conform to AWS A5.8.

2.9.9.7 Brazing Flux

Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides, and contain fluorides. Silver brazing materials shall be in accordance with AWS A5.8.

2.9.9.8 Solder Material

Solder metal shall conform to ASTM B 32 95-5 tin-antimony.

2.9.9.9 Solder Flux

Flux shall be either liquid or paste form, non-corrosive and conform to ASTM B 813.

2.9.9.10 Grooved Mechanical Fittings

Joints and fittings shall be designed for not less than 862 kPa (125 psig) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be ductile iron conforming to ASTM A 536. Gaskets shall be molded synthetic rubber with central cavity, pressure responsible configuration and shall conform to ASTM D 2000, for circulating medium up to 110 degrees C (230 degrees F). Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.9.10 Dielectric Waterways and Flanges

Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways.

2.9.11 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 861.8 kPa (125 psi) or 1034.2 kPa (150 psi) service. Connectors shall be installed where indicated and where required for building seismic joints. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. Materials used and the configuration shall be suitable for the pressure, vacuum, and temperature medium. The flexible section shall be suitable for service intended and may have threaded, welded, soldered, flanged, or socket ends. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium,

shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.9.12 Pipe Supports

Pipe supports shall conform to MSS SP-58 and MSS SP-69.

2.9.13 Pipe Expansion and Seismic Joints

2.9.13.1 Expansion Loops

Expansion loops and offsets shall provide adequate expansion of the main straight runs of the system within the stress limits specified in ASME B31.1. The loops and offsets shall be cold-sprung and installed where required or as indicated. Pipe guides and anchors shall be provided as required or indicated. Contractor shall be responsible for the design of the expansion loops.

2.9.13.2 Expansion Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the transverse indicated. The joints shall be designed for a hot water working pressure not less than 850 kPa (125 psig) and shall be in accordance with applicable requirements of EJMA Stds and ASME B31.1. End connection shall be flanged. Anchor bases or support bases shall be provided as indicated or required. Sliding surfaces and water wetted surfaces shall be chromium plated or fabricated of corrosion resistant steel. Initial setting shall be made in accordance with the manufacturer's recommendations to compensate for an ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall not be more than 1.5 m (5 feet) from expansion joint, except in lines 100 mm (4 inches) or smaller guides shall be installed not more than 600 mm (2 feet) from the joint. Service outlets shall be provided where indicated.

- a. Bellows-type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows-type expansion joints shall conform to the applicable requirements of EJMA Stds and ASME B31.1 with internal lines. Guiding of piping on both sides of expansion joint shall be in accordance with the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but shall not be less than 1135 kPa (150 psig).
- b. Flexible ball joints shall be constructed of alloys as appropriate for the service intended. The joints shall be threaded, grooved, flanged, or welded end as required and shall be capable of absorbing the normal operating axial, lateral, or angular movements or combination thereof. Balls and sockets shall be polished, chromium-plated when materials are not of corrosion-resistant steel. The ball type joint shall be designed and constructed in accordance with ASME B31.1 and EJMA Stds. Flanges shall conform to the diameter and drilling of ASME B16.5. Molded gaskets shall be suitable for the service intended.
- c. Slip type expansion joints shall be EJMA Stds and ASME B31.1, Class 1 or 2. Type II joints shall be suitable for repacking under full line pressure.

2.9.13.3 Seismic Loop Joints

Seismic loop joints shall be flexible hose type expansion joints consisting of two flexible sections of hose and braid, two 90 degree elbows, and a 180 degree return. Where nested loops are required or provided, the 180 degree return may be two 90's separated by either a third section of hose and braid, or a straight section of pipe with two 90 degree elbows. Loops shall be installed in a neutral condition for all seismic type joints. The seismic loop joints shall be anchored to the structure on both sides of

the building seismic joint, unless the seismic joint is concurrently being used to accommodate thermal expansion. Where the loops act both for seismic protection and thermal expansion, the loop shall be capable of providing the necessary seismic deflections in both the contracted and expanded conditions of the piping system. The pipe shall be anchored and guided sufficiently to ensure that axial loads in compression cannot cause buckling given the concurrent seismic loads that would be imposed horizontally along the length of the pipe.

2.9.14 Valves

Valves shall be Class 125 and shall be suitable for the application. Grooved ends per AWWA C606 may be used for water service only. Valves in nonboiler external piping shall meet the material, fabrication and operating requirements of ASME B31.1. The connection type of all valves shall match the same type of connection required for the piping on which installed. Isolation valves shall be provided so as to allow maintenance of portions of the system without having to shutdown the entire building. Isolation valves shall be provided on the following:

- Coil connections
- Equipment
- Automatic air vents
- Expansion tanks and air separators
- Terminal units
- At each floor of the building

2.9.14.1 Gate Valves

Gate valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 bronze rising stem, threaded, solder, or flanged ends. Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70 cast iron bronze trim, outside screw and yoke, flanged, or threaded ends.

2.9.14.2 Globe Valves

Globe valves 65 mm (2-1/2 inches) inches and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm (3 inches) and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.9.14.3 Check Valves

Check valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Check valves 80 mm (3 inches) and larger shall conform to MSS SP-71, cast iron, bronze trim, flanged, or threaded ends.

2.9.14.4 Angle Valves

Angle valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 bronze, threaded, soldered, or flanged ends. Angle valves 80 mm (3 inches) and larger shall conform to MSS SP-85, cast iron, bronze trim, flanged, or threaded ends.

2.9.14.5 Ball Valves

Ball valves 15 mm (1/2 inch) and larger shall conform to MSS SP-72 or MSS SP-110, ductile iron or bronze, threaded, soldered, or flanged ends.

2.9.14.6 Plug Valves

Plug valves 51 mm (2 inch) and larger shall conform to MSS SP-78. Plug valves smaller than 51 mm (2 inch) shall conform to ASME B16.34.

2.9.14.7 Grooved End Valves

Valves with grooved ends per AWWA C606 may be used if the valve manufacturer certifies that their performance meets the requirements of the standards indicated for each type of valve.

2.9.14.8 Balancing Valves

Balancing valves shall have meter connections with positive shutoff valves. An integral pointer shall register the degree of valve opening. Valves shall be calibrated so that flow rate can be determined when valve opening in degrees and pressure differential across valve is known. Each balancing valve shall be constructed with internal seals to prevent leakage and shall be supplied with preformed insulation. Valves shall be suitable for 120 degrees C (250 degrees F) temperature and working pressure of the pipe in which installed. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential. One portable differential meter shall be furnished. The meter suitable for the operating pressure specified shall be complete with hoses, vent, and shutoff valves, and carrying case. In lieu of the balancing valve with integral metering connections, a ball valve or plug valve with a separately installed orifice plate or venturi tube may be used for balancing.

2.9.14.9 Automatic Flow Control Valves

In lieu of the specified balancing valves, automatic flow control valves may be provided to maintain constant flow and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 850 kPa (125 psi) or 150 percent of the system operating pressure, whichever is greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased. Valves shall be suitable for 120 degrees C (250 degrees F) temperature service. Valve materials shall be same as specified for the heating system check, globe, angle, and gate valves. Valve operator shall be the electric motor type or pneumatic type as applicable. Valve operator shall be capable of positive shutoff against the system pump head. Valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter shall be provided with accessory kit as recommended for the project by the automatic valve manufacturer.

2.9.14.10 Butterfly Valves

Butterfly valves shall be 2-flange type or lug wafer type, and shall be bubbletight at 1135 kPa (150 psig). Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze, or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm 8 inches shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.9.14.11 Drain valves

Drain valves shall be provided at each drain point of blowdown as recommended by the boiler manufacturer. Piping shall conform to ASME BPV IV and ASTM A 53/A 53M.

2.9.14.12 Safety Valves

Safety valves shall have steel bodies and shall be equipped with corrosion-resistant trim and valve seats. The valves shall be properly guided and shall be positive closing so that no leakage can occur. Adjustment of the desired back-pressure shall cover the range between 15 and 70 kPa (2 and 10 psig). The adjustment shall be made externally, and any shafts extending through the valve body shall be provided with adjustable stuffing boxes having renewable packing. Boiler safety valves of proper size and of the required number, in accordance with ASME BPV IV, shall be installed so that the discharge will be through piping extended to a safe location. Each discharge pipe for hot water service shall be pitched away from the valve seat.

2.9.14.13 Finned Tube and Cabinet Convactor Radiator Valves

Automatic thermostatic radiator valves shall be self-contained remote sensor controlled nonelectric three-way temperature control valves. Valve bodies shall be constructed of chrome plated brass and shall be angle or straight pattern as indicated, with threaded or brazed end connections. Valve disc shall be of ethylene propylene or composition material. Thermostatic operators shall be a modulating type consisting of a sensing unit counter balanced by a spring setting. Provide with remote sensing bulb and all tubing required for operation.

2.9.15 Strainers

Basket and "Y" type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, fabricated of cast iron, and shall have bottoms drilled and tapped with a gate valve attached for blowdown purposes. Strainers shall be designed for 850 kPa (125 psig) service and 120 degrees C (250 degrees F). The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment screen. The screen shall be made of 0.795 mm thick (22 gauge) brass sheet, monel, or corrosion-resistant steel with small perforations numbering not less than 620,000 per square m (400 per square inch) to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.9.16 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shutoff valve. Pressure gauges shall be oil or glycerin filled. Minimum dial size shall be 90 mm (3-1/2 inches). A pressure gauge shall be provided for each boiler in a visible location on the boiler. Pressure gauges shall be provided with readings in kPa and psi. Pressure gauges shall have an indicating pressure range that is related to the operating pressure of the fluid in accordance with the following table:

Operating Pressure (kPa)	Pressure Range (kPa)
519-1030	0-1400
105-518	0-690
14-104	0-210 (retard)
Operating Pressure (psi)	Pressure Range (psi)
76-150	0-200
16-75	0-100
2-15	0-30 (retard)

2.9.17 Thermometers

Thermometers shall be provided with wells and separable corrosion-resistant steel sockets. Thermometers for inlet water and outlet water for each hot water boiler shall be provided in a visible location on the boiler. Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a minimum 225 mm (9 inch) scale. The operating range of the thermometers shall be 0-100 degrees centigrade (32 - 212 degrees Fahrenheit). The thermometers shall be provided with readings in degrees centigrade and Fahrenheit.

2.9.18 Air Vents

2.9.18.1 Manual Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for the pressure rating of the piping system and furnished with threaded plugs or caps. Air vents installed in piping in chase walls or other inaccessible places shall be provided with an access panel.

2.9.18.2 Automatic Air Vents

Automatic air vents shall be 20 mm (3/4 inch) quick-venting float and vacuum air valves. Each air vent valve shall have a large port permitting the expulsion of the air without developing excessive back pressure, a noncollapsible metal float which will close the valve and prevent the loss of water from the system, an air seal that will effectively close and prevent the re-entry of air into the system when subatmospheric pressures prevail therein. The name of the manufacturer shall be clearly stamped on the outside of each valve. The air vent valve shall be suitable for the pressure rating of the piping system.

2.10 RADIATORS AND CONVECTORS

Radiator and convector enclosures shall be coated with the manufacturer's standard rust inhibiting primer. All other exposed heating equipment shall be painted at the factory with the manufacturer's standard primer and enamel finish.

The radiator and convector shall be the type and size indicated. The supply and return connections shall be the same size. Cast iron radiators and nonferrous convectors shall be tested hydrostatically at the factory and proved tight under a pressure of not less than 300 psig. A certified report of these tests shall be furnished in accordance with paragraph SUBMITTALS.

2.10.1 Extended-Surface, Steel, or Nonferrous Tube-Type Radiators

Radiators shall consist of metal fins permanently bonded to steel or nonferrous pipe cores, with threaded or sweat fittings at each end for connecting to external piping. Radiators shall have capacities not less than those indicated, determined in accordance with HYI-01. Radiators shall be equipped with solid-front, slotted sloping-top cover grilles fabricated from black steel sheets not less than 16 gauge, independently secured to masonry with brackets.

2.10.2 Convectors

Convectors shall be constructed of cast iron or of nonferrous alloys, and shall be installed where indicated. Capacity of convectors shall be as indicated. Overall space requirements for convectors shall not be greater than the space provided. Convectors shall be complete with heating elements and enclosing cabinets having bottom recirculating opening, manual control damper and top supply grille. Convector cabinets shall be constructed of black sheet steel not less than 20 gauge.

2.10.3 Radiators and Convectors Control

The space temperature shall be maintained automatically by regulating water flow to the radiators and convectors by the self contained, automatic thermostatic radiator control valves.

2.11 UNIT HEATERS

Heaters shall be as specified below, and shall have a capacity not in excess of 125 percent of the capacity indicated.

2.11.1 Propeller Fan Heaters

Heaters shall be designed for suspension and arranged for horizontal discharge of air as indicated. Casings shall be not less than 20 gauge black steel and finished with lacquer or enamel. Suitable stationary air deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal discharge type unit heaters shall have discharge or face velocities not in excess of the following:

Unit Capacity, L/s	Face Velocity, m/s
Up to 500	4
501 to 1,400	4.5
1,401 and over	5

2.11.3 Heating Elements

Heating coils and radiating fins shall be of suitable nonferrous alloy with brazed fittings at each end for connecting to external piping. The heating elements shall be free to expand or contract without developing leaks and shall be properly pitched for drainage. The elements shall be tested under a hydrostatic pressure of 200 psig and a certified report of the test shall be submitted to the Contracting Officer. Coils shall be suitable for use with water up to 120 degrees C (250 degrees F).

2.11.4 Motors

Motors shall be provided with NEMA 250 general purpose enclosure. Motors and motor controls shall otherwise be as specified in Section 16415 ELECTRICAL WORK, INTERIOR.

2.11.5 Motor Switches

Motors shall be provided with manual selection switches with "On," "Off," and "Automatic" positions and shall be equipped with thermal overload protection.

2.11.6 Controls

Controls shall be provided as specified in Section 15950 HEATING, VENTILATING, AND AIR CONDITIONING HVAC CONTROL SYSTEMS.

2.12 ELECTRICAL EQUIPMENT

Electric motor-driven equipment shall be provided complete with motors, motor starters, and necessary control devices. Electrical equipment, motor control devices, motor efficiencies and wiring shall be as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Motors which are not an integral part of a packaged boiler shall be rated for high efficiency service. Motors which are an integral part of the packaged boiler shall be the highest efficiency available by the manufacturer of the packaged boiler. Motor starters shall be provided complete with properly sized thermal overload protections and other

appurtenances necessary for the motor control specified. Starters shall be furnished in general purpose enclosures. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices but not shown shall be provided.

2.12.1 Motor Ratings

Motors shall be suitable for the voltage and frequency provided. Motors 375 W (1/2 hp) and larger shall be three-phase, unless otherwise indicated. Motors shall be of sufficient capacity to drive the equipment at the specified capacity without exceeding the nameplate rating on the motor.

2.12.2 Motor Controls

Motor controllers shall be provided complete with properly sized thermal overload protection. Manual or automatic control and protective or signal devices required for the operation specified and any wiring required to such devices shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controllers may be provided to accomplish the same function. Solid state variable speed controllers shall be utilized for fractional through 7.46 kW (10 hp) ratings. Adjustable frequency drives shall be used for larger motors.

2.13 INSULATION

Shop and field-applied insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.14 TOOLS

Special tools shall be furnished. Special tools shall include uncommon tools necessary for the operation and maintenance of boilers, burners, pumps, fans, controls, meters, special piping systems, and other equipment. Small hand tools shall be furnished within a suitable cabinet, mounted where directed.

2.14.1 Breeching Cleaner

A cleaner shall be provided to clean the breeching. The cleaner shall have a jointed handle of sufficient length to clean the breeching without dismantling.

2.14.2 Tube Cleaner

If a watertube boiler is being furnished, a water-driven tube cleaner with three rotary cutters and rotary wire brush complete with the necessary length of armored water hose, valves, and other appurtenances necessary for operation shall be provided. Tube cleaner and rotary brush shall be provided for each size of water tube in the boiler, with one extra set of cutters for each size cleaner. Necessary valves and fittings shall be provided to permit ready connection of the cleaner hose to a high-pressure pump for cold water supply to operate the cleaner.

2.14.3 Tube Brush

If a firetube boiler is being furnished, a tube brush, with steel bristles and jointed handle of sufficient length to clean full length of firetubes, shall be provided.

2.14.4 Wrenches

Wrenches shall be provided as required for specialty fittings such as manholes, handholes, and cleanouts. One set of extra gaskets shall be provided for all manholes and handholes, for pump barrels, and other similar items of equipment. Gaskets shall be packaged and properly identified.

2.15 FUEL STORAGE SYSTEM

The fuel oil storage system shall be as specified in Section 13202A LPG FUEL STORAGE SYSTEMS unless noted otherwise.

2.16 BOILER WATER TREATMENT

The water treatment system shall be capable of feeding chemicals and bleeding the system to prevent corrosion and scale within the boiler and piping distribution system. The water shall be treated to maintain the conditions recommended by the boiler manufacturer. Chemicals shall meet required federal, state, and local environmental regulations for the treatment of boilers and discharge to the sanitary sewer. The services of a company regularly engaged in the treatment of boilers shall be used to determine the correct chemicals and concentrations required for water treatment. The company shall maintain the chemical treatment and provide all chemicals required for a period of 1 year from the date of occupancy. Filming amines and proprietary chemicals shall not be used. The water treatment chemicals shall remain stable throughout the operating temperature range of the system and shall be compatible with pump seals and other elements of the system.

2.16.1 Make Up Water Analysis

The makeup water conditions reported per ASTM D 596 shall be determined by the contractor and reported for use by the company that will provide chemical treatment services. The reported conditions shall be as follows:

Date of Sample	[_____]
Temperature	[_____] degrees C degrees F
Silica (SiO ₂)	[_____] ppm (mg/l)
Insoluble	[_____] ppm (mg/l)
Iron and Aluminum Oxides	[_____] ppm (mg/l)
Calcium (Ca)	[_____] ppm (mg/l)
Magnesium (Mg)	[_____] ppm (mg/l)
Sodium and Potassium (Na and K)	[_____] ppm (mg/l)
Carbonate (HCO ₃)	[_____] ppm (mg/l)
Sulfate (SO ₄)	[_____] ppm (mg/l)
Chloride (Cl)	[_____] ppm (mg/l)
Nitrate (NO ₃)	[_____] ppm (mg/l)
Turbidity	[_____] unit
pH	[_____]
Residual Chlorine	[_____] ppm (mg/l)
Total Alkalinity	[_____] epm (meq/l)
Noncarbonate Hardness	[_____] epm (meq/l)
Total Hardness	[_____] epm (meq/l)
Dissolved Solids	[_____] ppm (mg/l)
Fluorine	[_____] ppm (mg/l)
Conductivity	[_____] micro-mho/cm

2.16.2 Boiler Water Limits

The boiler manufacturer shall be consulted for the determination of the boiler water chemical composition limits. The boiler water limits shall be as follows unless dictated differently by the boiler manufacturer's recommendations:

Causticity	20-200 ppm
Total Alkalinity (CaCO ₃)	900-1200 ppm
Phosphate	30-60 ppm

Tannin	Medium
Dissolved Solids	3000-5000 ppm
Suspended Solids	300 ppm Max
Sodium Sulfite	20-40 ppm Max
Silica	Less than 150 ppm
Dissolved Oxygen	Less than 7 ppm
Iron	10 ppm
pH (Condensate)	7 - 8]
Sodium Sulfite	20-40 ppm
Hardness	Less than 2 ppm
pH	9.3 - 9.9]

2.16.3 Water Meter

The water meter shall be provided with an electric contacting register and remote accumulative counter. The meter shall be installed within the makeup water line, as indicated.

2.16.4 Chemical Shot Feeder

A shot feeder shall be provided as indicated. Size and capacity of feeder shall be based upon local requirements and water analysis. The feeder shall be furnished with an air vent, gauge glass, funnel, valves, fittings, and piping.

2.16.5 Chemical Piping

The piping and fittings shall be constructed of steel.

2.16.6 Test Kits

One test kit of each type required to determine the water quality as outlined within the operation and maintenance manuals shall be provided.

PART 3 EXECUTION

3.1 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed in accordance with manufacturer's written instructions. Proper provision shall be made for expansion and contraction between boiler foundation and floor. This joint shall be packed with suitable nonasbestos rope and filled with suitable compound that will not become soft at a temperature of 40 degrees C (100 degrees F). Boilers and firing equipment shall be supported from the foundations by structural steel completely independent of all brickwork. Boiler supports shall permit free expansion and contraction of each portion of the boiler without placing undue stress on any part of the boiler or setting. Boiler breeching shall be as indicated with full provision for expansion and contraction between all interconnected components.

3.2 PIPING INSTALLATION

Unless otherwise specified, nonboiler external pipe and fittings shall conform to the requirements of ASME B31.1. Pipe installed shall be cut accurately to suit field conditions, shall be installed without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Pipes shall be free of burrs, oil, grease and other foreign material and shall be installed to permit free expansion and contraction without damaging the building structure, pipe, pipe joints, or pipe supports. Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of

bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Vent pipes shall be carried through the roof as directed and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 0.2 percent (1 inch in 40 feet). Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise specified shall be uncoated. Unless otherwise specified or shown, final connections to equipment shall be made with malleable-iron unions for steel pipe 65 mm (2-1/2 inches) or less in diameter and with flanges for pipe 80 mm (3 inches) or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Reducing fittings shall be used for changes in pipe sizes. In horizontal hot water lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level to prevent air binding.

3.2.1 Hot Water Piping and Fittings

Pipe shall be black steel or copper tubing. Fittings for steel piping shall be black malleable iron or cast iron to suit piping. Fittings adjacent to valves shall suit valve material. Grooved mechanical fittings will not be allowed for water temperatures above 110 degrees C (230 degrees F).

3.2.2 Vent Piping and Fittings

Vent piping shall be black steel. Fittings shall be black malleable iron or cast iron to suit piping.

3.2.3 Gauge Piping

Piping shall be copper tubing.

3.2.4 Joints

Joints between sections of steel pipe and between steel pipe and fittings shall be threaded, grooved, flanged or welded as indicated or specified. Except as otherwise specified, fittings 25 mm (1 inch) and smaller shall be threaded; fittings 32 mm (1-1/4 inches) and up to but not including 80 mm (3 inches) shall be either threaded, grooved, or welded; and fittings 80 mm (3 inches) and larger shall be either flanged, grooved, or welded. Pipe and fittings 32 mm (1-1/4 inches) and larger installed in inaccessible conduit or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 65 mm (2-1/2 inches) or smaller in diameter and with flanges for pipe 80 mm (3 inches) or larger in diameter. Joints between sections of copper tubing or pipe shall be flared, soldered, or brazed.

3.2.4.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil or with polytetrafluoroethylene tape applied to the male threads only and in no case to the fittings.

3.2.4.2 Welded Joints

Welded joints shall be in accordance with paragraph GENERAL REQUIREMENTS unless otherwise specified. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1.5 mm (1/16) inch and no more than 3 mm (1/8 inch).

3.2.4.3 Grooved Mechanical Joints

Grooved mechanical joints may be provided for hot water systems in lieu of unions, welded, flanged, or screwed piping connections in low temperature hot water systems where the temperature of the circulating medium does not exceed 110 degrees C (230 degrees F). Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, narrow-land micrometer or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations. Mechanical joints shall use rigid mechanical pipe couplings, except at equipment connections. At equipment connections, flexible couplings may be used. Coupling shall be of the bolted type for use with grooved end pipes, fittings, valves, and strainers. Couplings shall be self-centering and shall engage in a watertight couple.

3.2.4.4 Flared and Brazed Copper Pipe and Tubing

Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA Tube Handbook with flux. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver or a silver brazing filler metal. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided in all branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Flared or brazed copper tubing to pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing.

3.2.4.5 Soldered Joints

Soldered joints shall be made with flux and are only acceptable for lines 50 mm (2 inches) and smaller. Soldered joints shall conform to ASME B31.5 and CDA Tube Handbook.

3.2.4.6 Copper Tube Extracted Joint

An extruded mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.4.6 Seismic Loop Joints

Seismic loop joints shall be installed in accordance with manufacturer's recommendations, the requirements herein, and in accordance with Section 15070 Seismic Protection For Mechanical Equipment.

3.2.5 Flanges and Unions

Flanges shall be faced true, provided with 1.6 mm (1/16 inch) thick gaskets, and made square and tight. Where steel flanges mate with cast-iron flanged fittings, valves, or equipment, they shall be provided with flat faces and full face gaskets. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items. Dielectric pipe unions shall be provided between ferrous and nonferrous piping to prevent galvanic corrosion. The dielectric unions shall have metal connections on both ends. The ends shall be threaded, flanged, or brazed to match adjacent piping. The metal parts of the union shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist upon metal-to-metal contact. Gaskets, flanges, and unions shall be installed in accordance with manufacturer's recommendations.

3.2.6 Branch Connections

3.2.6.1 Branch Connections for Hot Water Systems

Branches from the main shall pitch up or down as shown to prevent air entrapment. Connections shall ensure unrestricted circulation, eliminate air pockets, and permit complete drainage of the system. Branches shall pitch with a grade of not less than 8 mm in 1 m (1 inch in 10 feet). When indicated, special flow fittings shall be installed on the mains to bypass portions of the water through each radiator. Special flow fittings shall be standard catalog products and shall be installed as recommended by the manufacturer.

3.2.7 Flared, Brazed, and Soldered Copper Pipe and Tubing

Copper tubing shall be flared, brazed, or soldered. Tubing shall be cut square, and burrs shall be removed. Both inside of fittings and outside of tubing shall be cleaned thoroughly with sand cloth or steel wire brush before brazing. Annealing of fittings and hard-drawn tubing shall not occur when making connections. Installation shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints for flared fittings shall be of the compression pattern. Swing joints or offsets shall be provided on branch connections, mains, and risers to provide for expansion and contraction forces without undue stress to the fittings or to short lengths of pipe or tubing. Pipe adapters shall be provided where necessary for joining threaded pipe to copper tubing. Brazed joints shall be made in conformance with MSS SP-73, and CDA Tube Handbook. Copper-to-copper joints shall include the use of copper-phosphorous or copper-phosphorous-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorous, copper-phosphorous-silver, or a silver brazing filler metal. Soldered joints shall be made with flux and are only acceptable for lines 50 mm (2 inches) or smaller. Soldered joints shall conform to ASME B31.5 and shall be in accordance with CDA Tube Handbook.

3.2.8 Copper Tube Extracted Joint

An extracted mechanical tee joint may be made in copper tube. Joint shall be produced with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, dimpled depth stops shall be provided. The branch tube shall be notched for proper penetration into fitting to assure a free flow joint. Extracted joints shall be brazed using a copper phosphorous classification brazing filler metal. Soldered joints will not be permitted.

3.2.9 Supports

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to

keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. Threaded rods which are used for support shall not be formed or bent.

3.2.9.1 Seismic Requirements for Supports and Structural Bracing

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment, but not shown, shall be provided in this section. Material used for supports shall be as specified in Section 05120 STRUCTURAL STEEL.

3.2.9.2 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe, if the clamp bottom does not extend through the insulation, and if the top clamp attachment does not contact the insulation during pipe movement.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.
- d. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. Field fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1500 mm (5 feet) apart at valves.
- h. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 4500 mm (15 feet), not more than 2400 mm (8 feet) from end of risers, and at vent terminations.
- i. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
 - (1) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm (4 inches) and larger, a Type 39 saddle may be welded to the pipe and freely rested on a steel plate. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rested on a steel slide plate.

(2) Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm (4 inches) or by an amount adequate for the insulation, whichever is greater.

- j. Except for Type 3, pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation.
- k. Piping in trenches shall be supported as indicated.
- l. Structural steel attachments and brackets required to support piping, headers, and equipment, but not shown, shall be provided under this section. Material and installation shall be as specified under Section 05120 STRUCTURAL STEEL. Pipe hanger loads suspended from steel joist between panel points shall not exceed 22 kg (50 pounds). Loads exceeding 22 kg (50 pounds) shall be suspended from panel points.

3.2.9.3 Multiple Pipe Runs

In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support member shall not exceed the hanger and support spacing required for any individual pipe in the multiple pipe run. The clips or clamps shall be rigidly attached to the common base member. A clearance of 3 mm (1/8 inch) shall be provided between the pipe insulation and the clip or clamp for piping which may be subjected to thermal expansion.

3.2.10 Anchors

Anchors shall be provided where necessary to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.2.11 Valves

Valves shall be installed where indicated, specified, and required for functioning and servicing of the systems. Valves shall be safely accessible. Swing check valves shall be installed upright in horizontal lines and in vertical lines only when flow is in the upward direction. Gate and globe valves shall be installed with stems horizontal or above. Valves to be brazed shall be disassembled prior to brazing and all packing removed. After brazing, the valves shall be allowed to cool before reassembling.

3.2.12 Pipe Sleeves

Pipe passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. A waterproofing clamping flange shall be installed as indicated where membranes are involved. Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof. Sleeves through walls shall be cut flush with wall surface. Sleeves through floors shall extend above top surface of floor a sufficient distance to allow proper flashing or finishing. Sleeves through roofs shall extend above the top surface of roof at least 150 mm (6 inches) for proper flashing or finishing. Unless otherwise indicated, sleeves shall be sized to provide a minimum clearance of 6 mm (1/4 inch) between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in waterproofing membrane floors, bearing walls, and wet areas shall be galvanized steel pipe or cast-iron pipe. Sleeves in nonbearing walls, floors, or ceilings

may be galvanized steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve in nonfire rated walls shall be sealed as indicated and specified in Section 07900 JOINT SEALING. Metal jackets shall be provided over insulation passing through exterior walls, firewalls, fire partitions, floors, or roofs.

- a. Metal jackets shall not be thinner than 0.1524 mm (0.006 inch) thick aluminum, if corrugated, and 0.4 mm (0.016 inch) thick aluminum, if smooth.
- b. Metal jackets shall be secured with aluminum or stainless steel bands not less than 9 mm (3/8 inch) wide and not more than 200 mm (8 inches) apart. When penetrating roofs and before fitting the metal jacket into place, a 15 mm (1/2 inch) wide strip of sealant shall be run vertically along the inside of the longitudinal joint of the metal jacket from a point below the backup material to a minimum height of 1000 mm (36 inches) above the roof. If the pipe turns from vertical to horizontal, the sealant strip shall be run to a point just beyond the first elbow. When penetrating waterproofing membrane for floors, the metal jacket shall extend from a point below the back-up material to a minimum distance of 50 mm (2 inches) above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm (12 inches) above material to a minimum distance of 50 mm (2 inches) above the flashing. For other areas, the metal jacket shall extend from a point below the backup material to a point 300 mm (12 inches) above the floor; when passing through walls above grade, the jacket shall extend at least 100 mm (4 inches) beyond each side of the wall.

3.2.12.1 Pipes Passing Through Waterproofing Membranes

In addition to the pipe sleeves referred to above, pipes passing through waterproofing membranes shall be provided with a 1.6 mm (4 pound) lead flashing or a 0.55 mm (16 ounce) copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and the skirt or flange shall extend not less than 200 mm inches from the pipe and shall set over the membrane in a trowelled coating of bituminous cement. The flashing shall extend above the roof or floor a minimum of 250 mm (10 inches). The annular space between the flashing and the bare pipe or between the flashing and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm (10 inches) in diameter which pass through waterproofing membrane may be installed through a cast-iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess.

3.2.12.2 Optional Modular Mechanical Sealing Assembly

At the option of the Contractor, a modular mechanical type sealing assembly may be installed in the annular space between the sleeve and conduit or pipe in lieu of a waterproofing clamping flange and caulking and sealing specified above. The seals shall include interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion-protected carbon steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.2.12.3 Optional Counterflashing

As alternates to caulking and sealing the annular space between the pipe and flashing or metal-jacket-covered insulation and flashing, counterflashing may consist of standard roof coupling for threaded pipe up to 150 mm (6 inches) in diameter, lead flashing sleeve for dry vents with the sleeve turned

down into the pipe to form a waterproof joint, or a tack-welded or banded-metal rain shield around the pipe, sealed as indicated.

3.2.12.4 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.2.13 Balancing Valves

Balancing valves shall be installed as indicated.

3.2.14 Thermometer Wells

A thermometer well shall be provided in each return line for each circuit in multicircuit systems.

3.2.15 Air Vents

Air vents shall be installed where shown or directed. Air vents shall be installed in piping at all system high points. The vent shall remain open until water rises in the tank or pipe to a predetermined level at which time it shall close tight. An overflow pipe from the vent shall be run to a point designated by the Contracting Officer's representative. The inlet to the air vent shall have a gate valve or ball valve.

3.2.16 Escutcheons

Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal spring tension or setscrews.

3.2.17 Drains

A drain connection with a 25 mm (1 inch) gate valve or 20 mm (3/4 inch) hose bib shall be installed at the lowest point in the return main near the boiler. In addition, threaded drain connections with threaded cap or plug shall be installed on the heat exchanger coil on each unit heater or unit ventilator and wherever required for thorough draining of the system.

3.2.18 Strainer Blow-Down Piping

Strainer blow-down connections shall be fitted with a black steel blow-down pipeline routed to an accessible location and provided with a blow-down ball valve.

3.2.19 Direct Venting for Combustion Intake Air and Exhaust Air

The intake air and exhaust vents shall be installed in accordance with NFPA 54 and boiler manufacturer's recommendations. The exhaust vent shall be sloped 20.8 mm per m (1/4 inch per ft) toward the boiler's flue gas condensate collection point.

3.3 GAS FUEL SYSTEM

Gas piping, fittings, valves, regulators, tests, cleaning, and adjustments shall be in accordance with the Section 15190 GAS PIPING SYSTEMS. NFPA 54 shall be complied with unless otherwise specified. Burners, pilots, and all accessories shall be listed in UL Gas & Oil Dir. The fuel system shall be provided with a gas tight, manually operated, UL listed stop valve at the gas-supply connections, a gas strainer, a pressure regulator, pressure gauges, a burner-control valve, a safety shutoff valve suitable for size of burner and sequence of operation, and other components required for safe, efficient, and

reliable operation as specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

3.4 FUEL SYSTEM

Fuel system shall be installed in accordance with NFPA 54, unless otherwise indicated.

3.4.1 Piping and Storage Tank

Fuel piping and storage tanks shall be installed in accordance with Section 13202A LPG FUEL STORAGE SYSTEMS, unless indicated otherwise.

3.4.2 Earthwork

Excavation and backfilling for tanks and piping shall be as specified in Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS.

3.5 Penetrations to Fire Rated Assemblies

Where pipe pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.6 COLOR CODE MARKING AND FIELD PAINTING

Color code marking of piping shall be as specified in Section 09900 PAINTING GENERAL. Ferrous metal not specified to be coated at the factory shall be cleaned, prepared, and painted as specified in Section 09900 PAINTING, GENERAL. Exposed pipe covering shall be painted as specified in Section 09900 PAINTING, GENERAL. Aluminum sheath over insulation shall not be painted.

3.7 TEST OF BACKFLOW PREVENTION ASSEMBLIES

Backflow prevention assemblies shall be tested in accordance with Section 15400, PLUMBING, GENERAL PURPOSE.

3.8 HEATING SYSTEM TESTS

Before any covering is installed on pipe or heating equipment, the entire heating system's piping, fittings, and terminal heating units shall be hydrostatically tested and proved tight at a pressure of 1-1/2 times the design working pressure, but not less than 689 kPa (100 psi). Before pressurizing system for test, items or equipment (e.g., vessels, pumps, instruments, controls, relief valves) rated for pressures below the test pressure shall be blanked off or replaced with spool pieces. Before balancing and final operating test, test blanks and spool pieces shall be removed; and protected instruments and equipment shall be reconnected. With equipment items protected, the system shall be pressurized to test pressure. Pressure shall be held for a period of time sufficient to inspect all welds, joints, and connections for leaks, but not less than 2 hours. No loss of pressure will be allowed. Leaks shall be repaired and repaired joints shall be retested. Repair joints shall not be allowed under the floor for floor radiant heating systems. If a leak occurs in tubing located under the floor in radiant heating systems, the entire zone that is leaking shall be replaced. If any repair is made above the floor for floor radiant heating systems, access shall be provided for the installed joint. Caulking of joints shall not be permitted. System shall be drained and after instruments and equipment are reconnected, the system shall be refilled with service medium and maximum operating pressure applied. The pressure shall be held while inspecting these joints and connections for leaks. The leaks shall be repaired and the repaired joints retested. Upon completion of hydrostatic tests and before acceptance of the installation, the Contractor shall balance the heating system in accordance with Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS; and operating tests required to demonstrate satisfactory functional and operational efficiency shall be performed. The operating test shall cover a

period of at least 24 hours for each system, and shall include, as a minimum, the following specific information in a report, together with conclusions as to the adequacy of the system:

- a. Certification of balancing.
- b. Time, date, and duration of test.
- c. Outside and inside dry bulb temperatures.
- d. Temperature of hot water supply leaving boiler.
- e. Temperature of heating return water from system at boiler inlet.
- f. Quantity of water feed to boiler.
- g. Boiler make, type, serial number, design pressure, and rated capacity.
- h. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for burner motor.
- i. Circulating pump make, model, and rated capacity, and ammeter and voltmeter readings for pump motor during operation.
- j. Flue-gas temperature at boiler outlet.
- k. Percent carbon dioxide in flue-gas.
- l. Grade or type and calorific value of fuel.
- m. Draft at boiler flue-gas exit.
- n. Draft or pressure in furnace.
- o. Quantity of water circulated.
- p. Quantity of fuel consumed.
- q. Stack emission pollutants concentration.

Indicating instruments shall be read at half-hour intervals unless otherwise directed. The Contractor shall furnish all instruments, equipment, and personnel required for the tests and balancing. Fuels, water, and electricity shall be obtained as specified in the SPECIAL CONTRACT REQUIREMENTS. Operating tests shall demonstrate that fuel burners and combustion and safety controls meet the requirements of ASME CSD-1, and ANSI Z21.13 as applicable.

3.8.1 Water Treatment Testing

3.8.1.1 Water Quality Test

The boiler water shall be analyzed prior to the acceptance of the facility by the water treatment company. The analysis shall include the following information recorded in accordance with ASTM D 596.

Date of Sample	[_____]
Temperature	[_____] degrees C degrees F
Silica (SiO ₂)	[_____] ppm (mg/l)

Insoluble	[_____]	ppm (mg/l)
Iron and Aluminum Oxides	[_____]	ppm (mg/l)
Calcium (Ca)	[_____]	ppm (mg/l)
Magnesium (Mg)	[_____]	ppm (mg/l)
Sodium and Potassium (Na and K)	[_____]	ppm (mg/l)
Carbonate (HCO ₃)	[_____]	ppm (mg/l)
Sulfate (SO ₄)	[_____]	ppm (mg/l)
Chloride (Cl)	[_____]	ppm (mg/l)
Nitrate (NO ₃)	[_____]	ppm (mg/l)
Turbidity	[_____]	unit
pH	[_____]	
Residual Chlorine	[_____]	ppm (mg/l)
Total Alkalinity	[_____]	epm (meq/l)
Noncarbonate Hardness	[_____]	epm (meq/l)
Total Hardness	[_____]	epm (meq/l)
Dissolved Solids	[_____]	ppm (mg/l)
Fluorine	[_____]	ppm (mg/l)
Conductivity	[_____]	micro-mho/cm

If the boiler water is not in conformance with the boiler manufacturer's recommendations, the water treatment company shall take corrective action.

3.8.1.2 Boiler/Piping Test

At the conclusion of the 1 year period, the boiler and condensate piping shall be inspected for problems due to corrosion and scale. If the boiler is found not to conform to the manufacturer's recommendations, and the water treatment company recommendations have been followed, the water treatment company shall provide all chemicals and labor for cleaning or repairing the equipment as required by the manufacturer's recommendations. If corrosion is found within the condensate piping, proper repairs shall be made by the water treatment company.

3.9 CLEANING

3.9.1 Boilers and Piping

After the hydrostatic tests have been made and before the system is balanced and operating tests are performed, the boilers and feed water piping shall be thoroughly cleaned by filling the system with a solution consisting of either 0.5 kg (1 pound) of caustic soda or 0.5 kg (1 pound) of trisodium phosphate per 100 L (50 gallons) of water. The proper safety precautions shall be observed in the handling and use of these chemicals. The water shall be heated to approximately 65 degrees C (150 degrees F) and the solution circulated in the system for a period of 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers and valves shall be thoroughly cleaned. Prior to operating tests, air shall be removed from all water systems by operating the air vents.

3.9.2 Heating Units

Inside space heating equipment, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with all traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided for fans that are operated during construction, and new filters shall be installed after construction dirt has been removed from the building, and the ducts, plenum, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.10 FUEL SYSTEM TESTS

3.10.1 Gas System Test

The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA 54.

3.11 FIELD TRAINING

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 16 hours of normal working time for each system and shall start after the system is functionally completed but prior to final acceptance tests. The field instructions shall cover all of the items contained in the approved operation and maintenance instructions, as well as demonstrations of routine maintenance operations and boiler safety devices. The Contracting Officer shall be notified at least 14 days prior to date of proposed conduction of the training course.

END OF SECTION

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SECTION 15895

AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 350	(1986) Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment
ARI 410	(1991) Forced-Circulation Air-Cooling and Air-Heating Coils
ARI 430	(1989) Central-Station Air-Handling Units
ARI 440	(1998) Room Fan-Coil and Unit Ventilator
ARI 445	(1987; R 1993) Room Air-Induction Units
ARI 880	(1998) Air Terminals
ARI Guideline D	(1996) Application and Installation of Central Station Air-Handling Units

AIR CONDITIONING CONTRACTORS OF AMERICA (ACCA)

ACCA Manual 4	(1990) Installation Techniques for Perimeter Heating & Cooling; 11th Edition
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AIR MOVEMENT AND CONTROL ASSOCIATION (AMCA)

AMCA 210	(1985) Laboratory Methods of Testing Fans for Rating
AMCA 300	(1996) Reverberant Room Method for Sound Testing of Fans

AMERICAN BEARING MANUFACTURERS ASSOCIATION (AFBMA)

AFBMA Std 9	(1990) Load Ratings and Fatigue Life for Ball Bearings
AFBMA Std 11	(1990) Load Ratings and Fatigue Life for Roller Bearings

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S12.32	(1990; R 1996) Precision Methods for the Determination of Sound Power Levels of Discrete-Frequency and Narrow-Band Noise Sources in Reverberation Rooms
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings
ASTM A 53/A 53M	(1999b) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 106	(1999el) Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 123/A 123M	(1997ael) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 167	(1999) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
ASTM A 181/A 181M	(1995b) Carbon Steel, Forgings for General-Purpose Piping
ASTM A 183	(1983; R 1998) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(1999a) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 234/A 234M	(1999) Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
ASTM A 536	(1999el) Ductile Iron Castings
ASTM A 733	(1999) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 924/A 924M	(1999) General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
ASTM B 62	(1993) Composition Bronze or Ounce Metal Castings
ASTM B 75	(1999) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 88	(1999) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM B 650	(1995) Electrodeposited Engineering Chromium Coatings on Ferrous Substrates
ASTM B 813	(1993) Liquid and Paste Fluxes for Soldering Applications for Copper and Copper Alloy Tube
ASTM C 916	(1985; R 1996el) Adhesives for Duct Thermal Insulation

ASTM C 1071	(1998) Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material)
ASTM D 520	(1984; R 1995e1) Zinc Dust Pigment
ASTM D 1384	(1997a) Corrosion Test for Engine Coolants in Glassware
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(1999) Rubber Products in Automotive Applications
ASTM D 2466	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2564	(1996a) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2855	(1996) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 3359	(1997) Measuring Adhesion by Tape Test
ASTM E 84	(1999) Surface Burning Characteristics of Building Materials
ASTM E 437	(1992; R 1997) Industrial Wire Cloth and Screens (Square Opening Series)
ASTM F 872	(1984; R 1990) Filter Units, Air-Conditioning: Viscous-Impingement Type, Cleanable
ASTM F 1199	(1988; R 1998) Cast (All Temperature and Pressures) and Welded Pipe Line Strainers (150 psig and 150 degrees F Maximum)

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING
ENGINEERS (ASHRAE)

ASHRAE 15	(1994) Safety Code for Mechanical Refrigeration
ASHRAE 52.1	(1992) Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter
ASHRAE 68	(1986) Laboratory Method of Testing In-Duct Sound Power Measurement Procedures for Fans
ASHRAE 70	(1991) Method of Testing for Rating the Performance of Air Outlets and Inlets
ASHRAE 84	(1991) Method of Testing Air-to-Air Heat Exchangers

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 1992) Pipe Threads, General Purpose (Inch)
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.5	(1996; B16.5a) Pipe Flanges and Flanged Fittings NPS 1/2 through NPS 24
ASME B16.9	(1993) Factory-Made Wrought Steel Buttwelding Fittings
ASME B16.11	(1996) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(1984; R 1994) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(1995; B16.22a1998) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.26	(1988) Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
ASME B31.1	(1998) Power Piping
ASME B40.1	(1991) Gauges - Pressure Indicating Dial Type - Elastic Element
ASME BPV IX	(1998) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C606	(1997) Grooved and Shouldered Joints
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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1	(2000) Structural Welding Code - Steel
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COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1419	(Rev D; Canc. Notice 1) Filter Element, Air Conditioning (Viscous-Impingement and Dry Types, Replaceable)
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EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(1998; 7th Edition) EJMA Standards
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INSTITUTE OF ENVIRONMENTAL SCIENCES (IES)

IES RP-CC-001.3	(1993) HEPA and ULPA Filters
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-58	(1993) Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(1996) Pipe Hangers and Supports - Selection and Application
MSS SP-70	(1998) Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(1997) Cast Iron Swing Check Valves, Flanges and Threaded Ends
MSS SP-72	(1999) Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-80	(1997) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(1994) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends
MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA MG 1	(1998) Motors and Generators
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1999) National Electrical Code
NFPA 90A	(1999) Installation of Air Conditioning and Ventilating Systems
NFPA 96	(1998) Ventilation Control and Fire Protection of Commercial Cooking Equipment

NORTH AMERICAN INSULATION MANUFACTURERS ASSOCIATION (NAIMA)

NAIMA AH115	(1993) Fibrous Glass Duct Construction Standards
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SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION
(SMACNA)

SMACNA HVAC Duct Const Stds	(1995; Addenda Nov 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA Industry Practice	(1975) Accepted Industry Practice for Industrial Duct Construction

SMACNA Install Fire Damp HVAC	(1992) Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems
SMACNA Leakage Test Mnl	(1985) HVAC Air Duct Leakage Test Manual

UNDERWRITERS LABORATORIES (UL)

UL 94	(1996; Rev through Jul 1998) Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
UL 181	(1996; Rev Dec 1998) Factory-Made Air Ducts and Air Connectors
UL 214	(1997) Tests for Flame-Propagation of Fabrics and Films
UL 555	(1999) Fire Dampers
UL 586	(1996; Rev through Aug 1999) High-Efficiency, Particulate, Air Filter Units
UL 705	(1994; Rev through Feb 1999) Power Ventilators
UL 723	(1996; Rev through Dec 1998) Test for Surface Burning Characteristics of Building Materials
UL 900	(1994; Rev through Nov 1999) Test Performance of Air Filter Units
UL 1995	(1995; Rev through Aug 1999) Heating and Cooling Equipment
UL Bld Mat Dir	(1999) Building Materials Directory
UL Elec Const Dir	(1999) Electrical Construction Equipment Directory
UL Fire Resist Dir	(1999) Fire Resistance Directory (2 Vol.)

1.2 COORDINATION OF TRADES

Ductwork, piping offsets, fittings, and accessories shall be furnished as required to provide a complete installation and to eliminate interference with other construction.

1.3 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants.

1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Drawings; G
Installation; G

Drawings shall consist of equipment layout including assembly and installation details and electrical connection diagrams; ductwork layout showing the location of all supports and hangers, typical hanger details, gauge reinforcement, reinforcement spacing rigidity classification, and static pressure and seal classifications; and piping layout showing the location of all guides and anchors, the load imposed on each support or anchor, and typical support details. Drawings shall include any information required to demonstrate that the system has been coordinated and will properly function as a unit and shall show equipment relationship to other parts of the work, including clearances required for operation and maintenance.

SD-03 Product Data

Components and Equipment; G

Manufacturer's catalog data shall be included with the detail drawings for the following items. The data shall be highlighted to show model, size, options, etc., that are intended for consideration. Data shall be adequate to demonstrate compliance with contract requirements for the following:

- a. Piping Components
- b. Ductwork Components
- c. Air Systems Equipment
- d. Air Handling Units
- e. Energy Recovery Devices
- f. Terminal Units

Test Procedures;

Proposed test procedures for piping hydrostatic test, ductwork leak test, and performance tests of systems, at least 2 weeks prior to the start of related testing.

Welding Procedures;

A copy of qualified welding procedures, at least 2 weeks prior to the start of welding operations.

System Diagrams; G

Proposed diagrams, at least 2 weeks prior to start of related testing. System diagrams that show the layout of equipment, piping, and ductwork, and typed condensed operation manuals explaining preventative maintenance procedures, methods of checking the system for normal, safe operation, and procedures for safely starting and stopping the system shall be framed under glass or laminated plastic. After approval, these items shall be posted where directed.

Similar Services;

Statement demonstrating successful completion of similar services on at least 5 projects of similar size and scope, at least 2 weeks prior to submittal of other items required by this section.

Welding Joints;

A list of names and identification symbols of qualified welders and welding operators, at least 2 weeks prior to the start of welding operations.

Testing, Adjusting and Balancing; G

Proposed test schedules for hydrostatic test of piping, ductwork leak test, and performance tests, at least 2 weeks prior to the start of related testing.

Field Training;

Proposed schedule for field training, at least 2 weeks prior to the start of related training.

SD-06 Test Reports

Performance Tests;

Test reports for the piping hydrostatic test, ductwork leak test, and performance tests in booklet form, upon completion of testing. Reports shall document phases of tests performed including initial test summary, repairs/adjustments made, and final test results.

SD-07 Certificates

Bolts;

Written certification from the bolt manufacturer that the bolts furnished comply with the requirements of this specification. The certification shall include illustrations of product markings, and the number of each type of bolt to be furnished.

SD-10 Operation and Maintenance Data

Operating and Maintenance Instructions; GA

Six manuals listing step-by-step procedures required for system startup, operation, shutdown, and routine maintenance, at least 2 weeks prior to field training. The manuals shall include the manufacturer's name, model number, parts list, list of parts and tools that should be kept in stock by the owner for routine maintenance including the name of a local supplier, simplified wiring and controls diagrams, troubleshooting guide, and recommended service organization (including address and telephone number) for each item of equipment. Each service organization submitted shall be capable of providing 8 hour onsite response to a service call on an emergency basis.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Components and equipment shall be standard products of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship. The standard products shall have been in satisfactory commercial or industrial use for 2 years before bid opening.

The 2-year experience shall include applications of components and equipment under similar circumstances and of similar size. The 2 years must be satisfactorily completed by a product which has been sold or is offered for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures. Products having less than a 2-year field service record will be acceptable if a certified record of satisfactory field operation, for not less than 6000 hours exclusive of the manufacturer's factory tests, can be shown. The equipment items shall be supported by a service organization.

2.2 ASBESTOS PROHIBITION

Asbestos and asbestos-containing products shall not be used.

2.3 NAMEPLATES

Equipment shall have a nameplate that identifies the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.4 EQUIPMENT GUARDS AND ACCESS

Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact shall be fully enclosed or guarded according to OSHA requirements. High temperature equipment and piping exposed to contact by personnel or where it creates a potential fire hazard shall be properly guarded or covered with insulation of a type specified. Catwalks, operating platforms, ladders, and guardrails shall be provided where shown and shall be constructed according to Section 05500 MISCELLANEOUS METAL.

2.5 PIPING COMPONENTS

2.5.1 Steel Pipe

Steel pipe shall conform to ASTM A 53/A 53M, Schedule 40, Grade A or B, Type E or S.

2.5.2 Joints and Fittings For Steel Pipe

Joints shall be welded, flanged, threaded, or grooved as indicated. If not otherwise indicated, piping 25 mm (1 inch) and smaller shall be threaded; piping larger than 25 mm (1 inch) and smaller than 80 mm (3 inches) shall be either threaded, grooved, or welded; and piping 80 mm (3 inches) and larger shall be grooved, welded, or flanged. Rigid grooved mechanical joints and fittings may only be used in serviceable aboveground locations where the temperature of the circulating medium does not exceed 110 degrees C (230 degrees F). Flexible grooved joints shall be used only as a flexible connector with grooved pipe system. Unless otherwise specified, grooved piping components shall meet the corresponding criteria specified for the similar welded, flanged, or threaded component specified herein. The manufacturer of each fitting shall be permanently identified on the body of the fitting according to MSS SP-25.

2.5.2.1 Welded Joints and Fittings

Welded fittings shall conform to ASTM A 234/A 234M, and shall be identified with the appropriate grade and marking symbol. Butt-welded fittings shall conform to ASME B16.9. Socket-welded fittings shall conform to ASME B16.11.

2.5.2.2 Flanged Joints and Fittings

Flanges shall conform to ASTM A 181/A 181M and ASME B16.5, Class 150. Gaskets shall be nonasbestos compressed material according to ASME B16.21, 2.0 mm (1/16 inch) thickness, full face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene

rubber (SBR) or nitrile butadiene rubber (NBR). Bolts, nuts, and bolt patterns shall conform to ASME B16.5. Bolts shall be high or intermediate strength material conforming to ASTM A 193/A 193M.

2.5.2.3 Threaded Joints and Fittings

Threads shall conform to ASME B1.20.1. Unions shall conform to ASME B16.39, Class 150. Nipples shall conform to ASTM A 733. Malleable iron fittings shall conform to ASME B16.3, type as required to match piping.

2.5.2.4 Dielectric Unions and Flanges

Dielectric unions shall have the tensile strength and dimensional requirements specified. Unions shall have metal connections on both ends threaded to match adjacent piping. Metal parts of dielectric unions shall be separated with a nylon insulator to prevent current flow between dissimilar metals. Unions shall be suitable for the required operating pressures and temperatures. Dielectric flanges shall provide the same pressure ratings as standard flanges and provide complete electrical isolation.

2.5.2.5 Grooved Mechanical Joints and Fittings

Joints and fittings shall be designed for not less than 862 kPa (125 psig) service and shall be the product of the same manufacturer. Fitting and coupling houses shall be malleable iron conforming to ASTM A 47/A 47M, Grade 32510; ductile iron conforming to ASTM A 536, Grade 65-45-12; or steel conforming to ASTM A 106, Grade B or ASTM A 53/A 53M. Gaskets shall be molded synthetic rubber with central cavity, pressure responsive configuration and shall conform to ASTM D 2000 Grade No. 2CA615A15B44F17Z for circulating medium up to 110 degrees C (230 degrees F) or Grade No. M3BA610A15B44Z for circulating medium up to 93 degrees C (200 degrees F). Grooved joints shall conform to AWWA C606. Coupling nuts and bolts shall be steel and shall conform to ASTM A 183.

2.5.3 Copper Tube

Copper tube shall conform to ASTM B 88, and ASTM B 88M, Type K or L.

2.5.4 Joints and Fittings For Copper Tube

Wrought copper and bronze solder-joint pressure fittings shall conform to ASME B16.22 and ASTM B 75M. ASTM B 75. Cast copper alloy solder-joint pressure fittings shall conform to ASME B16.18. Cast copper alloy fittings for flared copper tube shall conform to ASME B16.26 and ASTM B 62. Brass or bronze adapters for brazed tubing may be used for connecting tubing to flanges and to threaded ends of valves and equipment. Extracted brazed tee joints produced with an acceptable tool and installed as recommended by the manufacturer may be used.

2.5.5 Valves

Valves shall be Class 125 and shall be suitable for the intended application. Valves shall meet the material, fabrication and operating requirements of ASME B31.1. Chain operators shall be provided for valves located 3 meters (10 feet) or higher above the floor. Valves in sizes larger than 25 mm (1 inch) and used on steel pipe systems, may be provided with rigid grooved mechanical joint ends. Such grooved end valves shall be subject to the same requirements as rigid grooved mechanical joints and fittings and, shall be provided by the same manufacturer as the grooved pipe joint and fitting system.

2.5.5.1 Gate Valves

Gate valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with rising stem and threaded, solder, or flanged ends. Gate valves 80 mm (3 inches) and larger shall conform to MSS SP-70 and shall be cast iron with bronze trim, outside screw and yoke, and flanged or threaded ends.

2.5.5.2 Globe Valves

Globe valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80, bronze, threaded, soldered, or flanged ends. Globe valves 80 mm (3 inches) and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.3 Check Valves

Check valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Check valves 80 mm (3 inches) and larger shall conform to MSS SP-71 and shall be cast iron with bronze trim and flanged or threaded ends.

2.5.5.4 Angle Valves

Angle valves 65 mm (2-1/2 inches) and smaller shall conform to MSS SP-80 and shall be bronze with threaded, soldered, or flanged ends. Angle valves 80 mm (3 inches) and larger shall conform to MSS SP-85 and shall be cast iron with bronze trim and flanged, or threaded ends.

2.5.5.5 Ball Valves

Ball valves 15 mm (1/2 inch) and larger shall conform to MSS SP-72 or MSS SP-110, and shall be ductile iron or bronze with threaded, soldered, or flanged ends.

2.5.5.6 Butterfly Valves

Butterfly valves shall be 2 flange or lug wafer type, and shall be bubble-tight at 1.03 MPa (150 psig). Valve bodies shall be cast iron, malleable iron, or steel. ASTM A 167, Type 404 or Type 316, corrosion resisting steel stems, bronze or corrosion resisting steel discs, and synthetic rubber seats shall be provided. Valves smaller than 200 mm (8 inches) shall have throttling handles with a minimum of seven locking positions. Valves 200 mm (8 inches) and larger shall have totally enclosed manual gear operators with adjustable balance return stops and position indicators. Valves in insulated lines shall have extended neck to accommodate insulation thickness.

2.5.5.7 Balancing Valves

Balancing valves 50 mm (2 inches) or smaller shall be bronze with NPT connections for black steel pipe and brazed connections for copper tubing. Valves 25 mm (1 inch) or larger may be all iron with threaded or flanged ends. The valves shall have a square head or similar device and an indicator arc and shall be designed for 120 degrees C (250 degrees F). Iron valves shall be lubricated, nonlubricated, or tetrafluoroethylene resin-coated plug valves. In lieu of plug valves, ball valves may be used. Plug valves and ball valves 200 mm (8 inches) or larger shall be provided with manual gear operators with position indicators. Where indicated, automatic flow control valves shall be provided to maintain constant flow, and shall be designed to be sensitive to pressure differential across the valve to provide the required opening. Valves shall be selected for the flow required and provided with a permanent nameplate or tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. Valves shall control the flow within 5 percent of the tag rating. Valves shall be suitable for the maximum operating pressure of 862 kPa (125 psig) or 150 percent of the system operating pressure, whichever is the greater. Where flow readings are provided by remote or portable meters, valve bodies shall be provided with tapped openings and pipe extensions with shutoff valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. A portable meter furnished with accessory kit as recommended by the automatic valve manufacturer shall be provided.

2.5.5.8 Air Vents

Manual air vents shall be brass or bronze valves or cocks suitable for pressure rating of piping system and furnished with threaded plugs or caps. Automatic air vents shall be float type, cast iron, stainless steel, or forged steel construction, suitable for pressure rating of piping system.

2.5.6 Strainers

Strainer shall be in accordance with ASTM F 1199, except as modified herein. Strainer shall be the cleanable, basket or "Y" type, the same size as the pipeline. The strainer bodies shall be fabricated of cast iron with bottoms drilled, and tapped. The bodies shall have arrows clearly cast on the sides indicating the direction of flow. Each strainer shall be equipped with removable cover and sediment screen. The screen shall be made of minimum 0.8 mm (22 gauge) brass sheet, monel, or corrosion-resistant steel, with small perforations numbering not less than 60 per square centimeter (400 per square inch) to provide a net free area through the basket of at least 3.3 times that of the entering pipe. The flow shall be into the screen and out through the perforations.

2.5.7 Water or Steam Heating System Accessories

Water heating accessories such as expansion tanks shall be as specified in Section 15569A WATER HEATING; GAS ; UP TO 20 MBTUH.

2.5.8 Glycol

The glycol shall be tested according to ASTM D 1384 and shall cause less than 0.0125 mm (0.5 mils) penetration per year for all system metals. The glycol shall contain corrosion inhibitors. Silicon based inhibitors shall not be used. The solution shall be compatible with all wetted items within the system.

2.5.9 Backflow Preventers

Backflow preventers shall be according to Section 15400 PLUMBING, GENERAL PURPOSE.

2.5.10 Flexible Pipe Connectors

Flexible pipe connectors shall be designed for 862 kPa (125 psi) or 1034 kPa (150 psi) service as appropriate for the static head plus the system head, and 120 degrees C, (250 degrees F), 110 degrees C (230 degrees F) for grooved end flexible connectors. The flexible section shall be constructed of rubber, tetrafluoroethylene resin, or corrosion-resisting steel, bronze, monel, or galvanized steel. The flexible section shall be suitable for intended service with end connections to match adjacent piping. Flanged assemblies shall be equipped with limit bolts to restrict maximum travel to the manufacturer's standard limits. Unless otherwise indicated, the length of the flexible connectors shall be as recommended by the manufacturer for the service intended. Internal sleeves or liners, compatible with circulating medium, shall be provided when recommended by the manufacturer. Covers to protect the bellows shall be provided where indicated.

2.5.11 Pressure Gauges

Gauges shall conform to ASME B40.1 and shall be provided with throttling type needle valve or a pulsation dampener and shut-off valve. Gauge shall be a minimum of 85 mm (3-1/2 inches) in diameter and shall have a range from 0 kPa (0 psig) to approximately 1.5 times the maximum system working pressure. Pressure gauges shall be oil or glycerin filled.

2.5.12 Thermometers

Thermometers shall have brass, malleable iron, or aluminum alloy case and frame, clear protective face, permanently stabilized glass tube with indicating-fluid column, white face, black numbers, and a 225 mm (9 inch) scale, and shall have rigid stems with straight, angular, or inclined pattern.

2.5.13 Escutcheons

Escutcheons shall be chromium-plated iron or chromium-plated brass, either one piece or split pattern, held in place by internal spring tension or setscrews.

2.5.14 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.5.15 Expansion Joints

2.5.15.1 Slip Joints

Expansion joints shall provide for either single or double slip of the connected pipes, as required or indicated, and for not less than the traverse indicated. The joints shall be designed for working temperature and pressure suitable for the application, but not less than 1034 kPa (150 psig), and shall be according to applicable requirements of EJMA Stds and ASME B31.1. End connections shall be flanged or beveled for welding as indicated. Joint shall be provided with an anchor base where required or indicated. Where adjoining pipe is carbon steel, the sliding slip shall be seamless steel plated with a minimum of 0.058 mm (2 mils) of hard chrome according to ASTM B 650. All joint components shall be suitable for the intended service. Initial setting shall be made according to the manufacturer's recommendations to compensate for ambient temperature at time of installation. Pipe alignment guides shall be installed as recommended by the joint manufacturer, but in any case shall be not more than 1.5 (4 inches) or smaller, guides shall be installed not more than 600 mm (2 feet) from the joint. Service outlets shall be provided where indicated.

2.5.15.2 Flexible Ball Joints

Flexible ball joints shall conform to EJMA Stds and ASME B31.1 and be constructed of alloys as appropriate for the service intended. Where so indicated, the ball joint shall be designed for packing injection under full line pressure to contain leakage. The joint ends shall be threaded to 50 mm (2 inches) only, grooved, flanged, or beveled for welding as indicated or required and shall be capable of absorbing a minimum of 15-degree angular flex and 360 degree rotation. Balls and sockets shall be suitable for the intended service. The exterior spherical surface of carbon steel balls shall be plated with mils of hard chrome according to ASTM B 650. The ball type joints shall be designed and constructed according to EJMA Stds and ASME B31.1 where applicable. Where required, flanges shall conform to ASME B16.5.

2.5.15.3 Bellows Type Joints

Bellows type joints shall be flexible, guided expansion joints. The expansion element shall be stabilized corrosion resistant steel. Bellows type expansion joints shall conform to the applicable requirements of EJMA Stds with internal sleeves. Guiding of piping on both sides of expansion joint shall be according to the published recommendations of the manufacturer of the expansion joint. The joints shall be designed for the working temperature and pressure suitable for the application but not less than 1034 kPa (150 psig).

2.5.17 Insulation

Shop and field applied insulation shall be as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. All insulation materials, including jackets used in the attic spaces shall be non-combustible.

2.6 ELECTRICAL WORK

Electrical motor-driven equipment specified shall be provided complete with motor, motor starter, and controls. Unless otherwise specified, electric equipment, including wiring and motor efficiencies, shall be according to Section 16415 ELECTRICAL WORK, INTERIOR. Electrical characteristics and enclosure type shall be as shown. Unless otherwise indicated, motors of 745 W (1 hp) and above shall be high efficiency type. Motor starters shall be provided complete with thermal overload protection and other appurtenances necessary. Each motor shall be according to NEMA MG 1 and shall be of sufficient size to drive the equipment at the specified capacity without exceeding the nameplate rating of the motor. Manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices, but not shown, shall be provided. Where two-speed or variable-speed motors are indicated, solid-state variable-speed controller may be provided to accomplish the same function. Solid-state variable-speed controllers shall be utilized for motors rated 7.45 kW (10 hp) or less. Adjustable frequency drives shall be used for larger motors.

2.7 CONTROLS

Controls shall be provided as specified in Section 15910 DIRECT DIGITAL CONTROL SYSTEMS.

2.8 DUCTWORK COMPONENTS

2.8.1 Metal Ductwork

All aspects of metal ductwork construction, including all fittings and components, shall comply with SMACNA HVAC Duct Const Stds unless otherwise specified. Elbows shall be radius type with a centerline radius of 1-1/2 times the width or diameter of the duct where space permits. Otherwise, elbows having a minimum radius equal to the width or diameter of the duct or square elbows with factory fabricated turning vanes may be used. Static pressure Class 125, 250, and 500 Pa (1/2, 1, and 2 inch w.g.) ductwork shall meet the requirements of Seal Class C. Class 750 through 2500 Pa (3 through 10 inch) shall meet the requirements of Seal Class A. Sealants shall conform to fire hazard classification specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Pressure sensitive tape shall not be used as a sealant. Spiral lock seam duct, and flat oval shall be made with duct sealant and locked with not less than 3 equally spaced drive screws or other approved methods indicated in SMACNA HVAC Duct Const Stds. The sealant shall be applied to the exposed male part of the fitting collar so that the sealer will be on the inside of the joint and fully protected by the metal of the duct fitting. One brush coat of the sealant shall be applied over the outside of the joint to at least 50 mm (2 inch) band width covering all screw heads and joint gap. Dents in the male portion of the slip fitting collar will not be acceptable. Outdoor air intake ducts and plenums shall be fabricated with watertight soldered or brazed joints and seams.

2.8.1.1 Transitions

Diverging air flow transitions shall be made with each side pitched out a maximum of 15 degrees, for an included angle of 30 degrees. Transitions for converging air flow shall be made with each side pitched in a maximum of 30 degrees, for an included angle of 60 degrees, or shall be as indicated. Factory-fabricated reducing fittings for systems using round duct sections when formed to the shape of the ASME short flow nozzle, need not comply with the maximum angles specified.

2.8.1.2 Metallic Flexible Duct

Metallic type duct shall be single-ply galvanized steel, Type 316 stainless steel, or two-ply aluminum, self supporting to 2.4 m (8 foot) spans. Duct shall be of corrugated/interlocked, folded and knurled type seam construction, bendable without damage through 180 degrees with a throat radius equal to 1/2 duct diameter. Duct shall conform to UL 181 and shall be rated for positive or negative working pressure of 3.75 kPa (15 inches water gauge) at 177 degrees C (350 degrees F) when duct is aluminum, and 343 degrees C (650 degrees F) when duct is galvanized steel or stainless steel.

2.8.1.3 Insulated Nonmetallic Flexible Duct Runouts

Flexible duct runouts shall be used only where indicated. Runout length shall be as shown on the drawings, but shall in no case exceed 3 m (10 feet). Runouts shall be preinsulated, factory fabricated, and shall comply with NFPA 90A and UL 181. Either field or factory applied vapor barrier shall be provided. Where coil induction or high velocity units are supplied with vertical air inlets, a streamlined and vaned and mitered elbow transition piece shall be provided for connection to the flexible duct or hose. The last elbow to these units, other than the vertical air inlet type, shall be a die-stamped elbow and not a flexible connector. Insulated flexible connectors may be used as runouts. The insulated material and vapor barrier shall conform to the requirements of Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. The insulation material surface shall not be exposed to the air stream.

2.8.1.4 General Service Duct Connectors

A flexible duct connector approximately 150 mm (6 inches) in width shall be provided where sheet metal connections are made to fans or where ducts of dissimilar metals are connected. For round/oval ducts, the flexible material shall be secured by stainless steel or zinc-coated, iron clinch-type draw bands. For rectangular ducts, the flexible material locked to metal collars shall be installed using normal duct construction methods. The composite connector system shall comply with UL 214 and be classified as "flame-retarded fabrics" in UL Bld Mat Dir.

2.8.1.5 High Temperature Service Duct Connections

Material shall be approximately 2.38 mm (3/32 inch) thick, 1.2 to 1.36 kg per square meter (35 to 40-ounce per square yard) weight, plain weave fibrous glass cloth with, nickel/chrome wire reinforcement for service in excess of 650 degrees C (1200 degrees F).

2.8.2 Ductwork Accessories

2.8.2.1 Duct Access Doors

Access doors shall be provided in ductwork and plenums where indicated and at all air flow measuring primaries, automatic dampers, fire dampers, coils, thermostats, and other apparatus requiring service and inspection in the duct system, and unless otherwise shown, shall conform to SMACNA HVAC Duct Const Stds. Access doors shall be provided upstream and downstream of air flow measuring primaries and heating and cooling coils. Doors shall be minimum 375 x 450 mm, (15 x 18 inches), unless otherwise shown. Where duct size will not accommodate this size door, the doors shall be made as large as practicable. Doors 600 x 600 mm (24 x 24 inches) or larger shall be provided with fasteners operable from both sides. Doors in insulated ducts shall be the insulated type.

2.8.2.2 Fire Dampers

Fire dampers shall be 1-1/2 hour fire rated unless otherwise indicated. Fire dampers shall conform to the requirements of NFPA 90A and UL 555. The Contractor shall perform the fire damper test as outlined in NFPA 90A. A pressure relief damper shall be provided upstream of the fire damper whenever the fan static pressure rating exceeds the duct pressure classification. If the ductwork

connected to the fire damper is to be insulated then this pressure relief damper shall be factory insulated. Fire dampers shall be automatic operating type and shall have a dynamic rating suitable for the maximum air velocity and pressure differential to which it will be subjected. Fire dampers shall be approved for the specific application, and shall be installed according to their listing. Fire dampers shall be equipped with a steel sleeve or adequately sized frame installed in such a manner that disruption of the attached ductwork, if any, will not impair the operation of the damper. Sleeves or frames shall be equipped with perimeter mounting angles attached on both sides of the wall or floor opening. Ductwork in fire-rated floor-ceiling or roof-ceiling assembly systems with air ducts that pierce the ceiling of the assemblies shall be constructed in conformance with UL Fire Resist Dir. Fire dampers shall be curtain type with damper blades out of the air stream or multi-blade type. Dampers shall not reduce the duct or the air transfer opening cross-sectional area. Dampers shall be installed so that the centerline of the damper depth or thickness is located in the centerline of the wall, partition or floor slab depth or thickness. Unless otherwise indicated, the installation details given in SMACNA Install Fire Damper HVAC and in manufacturer's instructions for fire dampers shall be followed.

2.8.2.3 Splitters and Manual Balancing Dampers

Splitters and manual balancing dampers shall be furnished with accessible operating mechanisms. Where operators occur in finished portions of the building, operators shall be chromium plated with all exposed edges rounded. Splitters shall be operated by quadrant operators or 5 mm (3/16 inch) rod brought through the side of the duct with locking setscrew and bushing. Two rods are required on splitters over 200 mm (8 inches). Manual volume control dampers shall be operated by locking-type quadrant operators. Dampers and splitters shall be 2 gauges heavier than the duct in which installed. Unless otherwise indicated, multileaf dampers shall be opposed blade type with maximum blade width of 300 mm (12 inches). Access doors or panels shall be provided for all concealed damper operators and locking setscrews. Unless otherwise indicated, the locking-type quadrant operators for dampers, when installed on ducts to be thermally insulated, shall be provided with stand-off mounting brackets, bases, or adapters to provide clearance between the duct surface and the operator not less than the thickness of the insulation. Stand-off mounting items shall be integral with the operator or standard accessory of the damper manufacturer. Volume dampers shall be provided where indicated.

2.8.2.4 Air Deflectors and Branch Connections

Air deflectors shall be provided at duct mounted supply outlets, at takeoff or extension collars to supply outlets, at duct branch takeoff connections, and at 90 degree elbows, as well as at locations as indicated on the drawings or otherwise specified. Conical branch connections or 45 degree entry connections may be used in lieu of deflectors or extractors for branch connections. All air deflectors, except those installed in 90 degree elbows, shall be provided with an approved means of adjustment. Adjustment shall be made from easily accessible means inside the duct or from an adjustment with sturdy lock on the face of the duct. When installed on ducts to be thermally insulated, external adjustments shall be provided with stand-off mounting brackets, integral with the adjustment device, to provide clearance between the duct surface and the adjustment device not less than the thickness of the thermal insulation. Air deflectors shall be factory-fabricated units consisting of curved turning vanes or louver blades designed to provide uniform air distribution and change of direction with minimum turbulence or pressure loss. Air deflectors shall be factory or field assembled. Blade air deflectors, also called blade air extractors, shall be approved factory fabricated units consisting of equalizing grid and adjustable blade and lock. Adjustment shall be easily made from the face of the diffuser or by position adjustment and lock external to the duct. Stand-off brackets shall be provided on insulated ducts and are described herein. Fixed air deflectors, also called turning vanes, shall be provided in 90 degree elbows.

2.8.4 Duct Sleeves, Framed Prepared Openings, Closure Collars

2.8.4.1 Duct Sleeves

Duct sleeves shall be provided for round ducts 375 mm (15 inches) in diameter or less passing through floors, walls, ceilings, or roof, and installed during construction of the floor, wall, ceiling, or roof. Round ducts larger than 375 mm (15 inches) in diameter and square, rectangular, and oval ducts passing through floors, walls, ceilings, or roof shall be installed through framed prepared openings. The Contractor shall be responsible for the proper size and location of sleeves and prepared openings. Sleeves and framed openings are also required where grilles, registers, and diffusers are installed at the openings. Framed prepared openings shall be fabricated from 1.0 mm (20 gauge) galvanized steel, unless otherwise indicated. Where sleeves are installed in bearing walls or partitions, black steel pipe, ASTM A 53/A 53M, Schedule 20 shall be used. Sleeve shall provide 25 mm (1 inch) clearance between the duct and the sleeve or 25 mm (1 inch) clearance between the insulation and the sleeve for insulated ducts.

2.8.4.2 Framed Prepared Openings

Openings shall have 25 mm (1 inch) clearance between the duct and the opening or 25 mm (1 inch) clearance between the insulation and the opening for insulated ducts.

2.8.4.3 Closure Collars

Collars shall be fabricated of galvanized sheet metal not less than 100 mm (4 inches) wide, unless otherwise indicated, and shall be installed on exposed ducts on each side of walls or floors where sleeves or prepared openings are provided. Collars shall be installed tight against surfaces. Collars shall fit snugly around the duct or insulation. Sharp edges of the collar around insulated duct shall be ground smooth to preclude tearing or puncturing the insulation covering or vapor barrier. Collars for round ducts 375 mm (15 inches) in diameter or less shall be fabricated from 1.0 mm (20 gauge) galvanized steel. Collars for round ducts larger than 375 mm (15 inches) and square, and rectangular ducts shall be fabricated from 1.3 mm (18 gauge) galvanized steel. Collars shall be installed with fasteners on maximum 150 mm (6 inch) centers, except that not less than 4 fasteners shall be used.

2.8.5 Plenums and Casings for Field-Fabricated Units

2.8.5.1 Plenum and Casings

Plenums and casings shall be fabricated and erected as shown in SMACNA HVAC Duct Const Stds, as applicable. Unless otherwise indicated, system casing shall be constructed of not less than 1.6 mm (16 gauge) galvanized sheet steel. Cooling coil drain pans with 25 mm (1 inch) threaded outlet shall be provided to collect condensation from the cooling coils. Drain pans shall be fabricated of not lighter than 1.6 mm (16 gauge) steel, galvanized after fabrication or of 1.3 mm (18 gauge) corrosion-resisting sheet steel conforming to ASTM A 167, Type 304, welded and stiffened. Drain pans exposed to the atmosphere shall be thermally insulated to prevent condensation. Insulation shall be coated with a flame resistant waterproofing material. Separate drain pans shall be provided for each vertical coil section, and a separate drain line shall be provided for each pan. Pans shall be generously sized to ensure capture of entrained moisture on the downstream-air side of the coil. Openings in the casing, such as for piping connections, shall be sealed and covered to prevent air leakage. Water seal for the drain shall provide at least 500 Pa (2 inch) water gauge greater than the maximum negative pressure in the coil space.

2.8.5.2 Casing

Casings shall be terminated at the curb line and anchored by the use of galvanized angle iron sealed and bolted to the curb, as indicated in SMACNA HVAC Duct Const Stds.

2.8.5.3 Access Doors

Access doors shall be provided in each section of the casing. Door frames shall be welded in place, and each door shall be neoprene gasketed, hinged with minimum of two brass hinges, and fastened with a minimum of two brass tension fasteners operable from inside and outside of the casing. Where possible, doors shall be 900 x 450 mm (36 x 18 inches) located 450 mm (18 inches) above the floor. Where the space available will not accommodate doors of this size, doors as large as the space will accommodate shall be provided. Doors shall swing so that fan suction or pressure holds door in closed position, and shall be airtight. A push-button station to stop the supply fan shall be located inside the casing where indicated.

2.8.5.4 Factory-Fabricated Insulated Sheet Metal Panels

Factory-fabricated components may be used for field-assembled units, provided all requirements specified for field-fabricated plenums and casings are met. Panels shall be of modular design, pretested for structural strength, thermal control, condensation control, and acoustical control. Panel joints shall be sealed and insulated access doors shall be provided and gasketed to prevent air leakage. Panel construction shall be not less than 1.0 mm (20 gauge) galvanized sheet steel and shall be assembled with fasteners treated against corrosion. Standard length panels shall deflect not more than 13 mm (1/2 inch) under operation. Details of construction, including joint sealing, not specifically covered shall be as indicated in SMACNA HVAC Duct Const Stds. The plenums and casings shall be constructed to withstand the specified internal pressure of the air systems.

2.8.5.5 Duct Liner

Unless otherwise specified, duct liner shall conform to ASTM C 1071, Type I or II.

2.8.6 Sound Attenuation Equipment

a. Systems With Total Pressure Above 1 kPa (4 Inches Water Gauge):

Sound attenuators shall be provided on the discharge duct of each fan operating at a total pressure above 1 kPa (4 inch water gauge), and, when indicated, at the intake of each fan system. Sound attenuators shall be provided elsewhere as indicated. The sound attenuators shall be factory fabricated and shall be tested by an independent laboratory for sound and performance characteristics. Net sound reduction shall be as indicated. Maximum permissible pressure drop shall not exceed 157 Pa (0.63 inch water gauge). Traps shall be constructed to be airtight when operating under an internal static pressure of 2.5 kPa (10 inch water gauge). Air-side surface shall be capable of withstanding air velocity of 50 m/s (10,000 fpm). The Contractor shall certify that the sound reduction values specified will be obtained after the equipment is installed in the system and coordinated with the sound information of the system fan to be provided. Sound absorbing material shall conform to ASTM C 1071, Type I or II. Sound absorbing material shall meet the fire hazard rating requirements for insulation specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. A duct transition section shall be provided for connection to ductwork. Factory fabricated double-walled internally insulated spiral lock seam and round duct and fittings designed for high pressure air system may be provided in lieu of factory fabricated sound attenuators, and shall comply with requirements specified for factory fabricated sound attenuators. The double-walled duct and fittings shall be constructed of an outer metal pressure shell of zinc-coated steel sheet, 25 mm (1 inch) thick acoustical blanket insulation, and an internal perforated zinc-coated metal liner. Sufficient length of run shall be provided to obtain the noise reduction coefficient specified. The Contractor shall certify that the sound reduction value specified will be obtained within the length of duct run provided. The outer sheet metal of the double-walled duct shall have welded, or spiral lock, seams to prevent water vapor penetration. The outer sheet of the duct and fittings shall conform to the metal thickness of high pressure spiral and round ducts and fittings shown in SMACNA HVAC Duct Const Stds. The acoustical insulation shall have a thermal conductivity "k" of not more than 0.0389 W/m-K (0.27 Btu/inch/square foot/hour/degree F) at 24 degrees C (75 degrees F) mean temperature. The internal perforated zinc-coated metal liner

shall be not less than 0.7 mm (24 gauge) with perforations not larger than 6.35 mm (1/4 inch) in diameter providing a net open area not less than 10 percent of the surface.

a. System With Total Pressure of 1000 Pa (4 Inch Water Gauge) and Lower:

Sound attenuators shall be provided only where indicated, or in lieu of lined ducts. Factory fabricated sound attenuators shall be constructed of galvanized steel sheets. Outer casing shall be not less than 0.85 mm (22 gauge). Acoustical fill shall be fibrous glass. Net sound reduction shall be as indicated. Values shall be obtained on a test unit not less than 600 mm (24 inches) by 600 mm (24 inches) outside dimensions made by a certified nationally recognized independent acoustical laboratory. Air flow capacity shall be as indicated or required. Pressure drop through the attenuator shall not exceed the value indicated, or shall not be in excess of 15 percent of the total external static pressure of the air handling system, whichever is less. Sound attenuators shall be acoustically tested with metal duct inlet and outlet sections while under the rated air flow conditions. Noise reduction data shall include the effects of flanking paths and vibration transmission. Sound attenuators shall be constructed to be airtight when operating at the internal static pressure indicated or specified for the duct system, but in no case less than 500 Pa (2 inch water gauge).

a. Acoustical Duct Liner:

Acoustical duct lining shall be fibrous glass designed exclusively for lining ductwork and shall conform to the requirements of ASTM C 1071, Type I and II. Liner composition may be uniform density, graduated density, or dual density, as standard with the manufacturer. Lining shall be coated, not less than 25 mm (1 inch) thick. Where acoustical duct liner is used, liner or combination of liner and insulation applied to the exterior of the ductwork shall be the thermal equivalent of the insulation specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Duct sizes shown shall be increased to compensate for the thickness of the lining used. In lieu of sheet metal duct with field-applied acoustical lining, acoustically equivalent lengths of fibrous glass duct or factory fabricated double-walled internally insulated duct with perforated liner may be provided. Net insertion loss value, static pressure drop, and air flow velocity capacity data shall be certified by a nationally recognized independent acoustical laboratory.

2.8.7 Diffusers, Registers, and Grilles

Units shall be factory-fabricated of steel, corrosion-resistant steel, or aluminum and shall distribute the specified quantity of air evenly over space intended without causing noticeable drafts, air movement faster than 0.25 m/s (50 fpm) in occupied zone, or dead spots anywhere in the conditioned area. Outlets for diffusion, spread, throw, and noise level shall be as required for specified performance. Performance shall be certified according to ASHRAE 70. Inlets and outlets shall be sound rated and certified according to ASHRAE 70. Sound power level shall be as indicated. Diffusers and registers shall be provided with volume damper with accessible operator, unless otherwise indicated; or if standard with the manufacturer, an automatically controlled device will be acceptable. Volume dampers shall be opposed blade type for all diffusers and registers, except linear slot diffusers. Linear slot diffusers shall be provided with round or elliptical balancing dampers. Where the inlet and outlet openings are located less than 2 m (7 feet) above the floor, they shall be protected by a grille or screen according to NFPA 90A.

2.8.7.1 Diffusers

Diffuser types shall be as indicated. Ceiling mounted units shall be furnished with anti-smudge devices, unless the diffuser unit minimizes ceiling smudging through design features. Diffusers shall be provided with air deflectors of the type indicated. Air handling troffers or combination light and ceiling diffusers shall conform to the requirements of UL Elec Const Dir for the interchangeable use as cooled or heated air supply diffusers or return air units. Ceiling mounted units shall be installed with rims tight against ceiling. Sponge rubber gaskets shall be provided between ceiling and surface mounted diffusers for air leakage control. Suitable trim shall be provided for flush mounted diffusers.

Duct collar connecting the duct to diffuser shall be airtight and shall not interfere with volume controller. Return or exhaust units shall be similar to supply diffusers.

2.8.7.2 Registers and Grilles

Units shall be four-way directional-control type, except that return and exhaust registers may be fixed horizontal or vertical louver type similar in appearance to the supply register face. Registers shall be provided with sponge-rubber gasket between flanges and wall or ceiling. Wall supply registers shall be installed at least 150 mm (6 inches) below the ceiling unless otherwise indicated. Return and exhaust registers shall be located 150 mm (6 inches) above the floor unless otherwise indicated. Four-way directional control may be achieved by a grille face which can be rotated in 4 positions or by adjustment of horizontal and vertical vanes. Grilles shall be as specified for registers, without volume control damper.

2.8.8 Louvers

Louvers for installation in exterior walls which are associated with the air supply and distribution system shall be as specified in Section 07600 SHEET METALWORK, GENERAL.

2.8.9 Air Vents, Penthouses, and Goosenecks

Air vents, penthouses, and goosenecks shall be fabricated from galvanized steel or aluminum sheets with galvanized or aluminum structural shapes. Sheet metal thickness, reinforcement, and fabrication shall conform to SMACNA HVAC Duct Const Stds. Louver blades shall be accurately fitted and secured to frames. Edges of louver blades shall be folded or beaded for rigidity and baffled to exclude driving rain. Air vents, penthouses, and goosenecks shall be provided with bird screen.

2.8.10 Bird Screens and Frames

Bird screens shall conform to ASTM E 437, No. 2 mesh, aluminum or stainless steel. Aluminum screens shall be rated "medium-light". Stainless steel screens shall be rated "light". Frames shall be removable type, or stainless steel or extruded aluminum.

2.8.11 Radon Exhaust Ductwork

Radon exhaust ductwork installed in or beneath slabs shall be fabricated from Schedule 40 PVC pipe that conforms to ASTM D 1785. Fittings shall conform to ASTM D 2466. Solvent cement used to make joints shall conform to ASTM D 2564. Otherwise radon exhaust ductwork shall be metal as specified herein.

2.9 AIR SYSTEMS EQUIPMENT

2.9.1 Fans

Fans shall be tested and rated according to AMCA 210. Fans may be connected to the motors either directly or indirectly with V-belt drive. V-belt drives shall be designed for not less than 150 percent of the connected driving capacity. Motor sheaves shall be variable pitch for 11 kW (15 hp) and below and fixed pitch as defined by ARI Guideline D. Variable pitch sheaves shall be selected to drive the fan at a speed which will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. When fixed pitch sheaves are furnished, a replaceable sheave shall be provided when needed to achieve system air balance. Motors for V-belt drives shall be provided with adjustable rails or bases. Removable metal guards shall be provided for all exposed V-belt drives, and speed-test openings shall be provided at the center of all rotating shafts. Fans shall be provided with personnel screens or guards on both suction and supply ends, except that the screens need not be provided, unless otherwise indicated, where ducts are connected to the fan. Fan and motor assemblies shall be provided with vibration-isolation supports or mountings as indicated. Vibration-isolation units shall be

standard products with published loading ratings. Each fan shall be selected to produce the capacity required at the fan static pressure indicated. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300. Standard AMCA arrangement, rotation, and discharge shall be as indicated.

2.9.1.1 Centrifugal Fans

Centrifugal fans shall be fully enclosed, single-width single-inlet, or double-width double-inlet, AMCA Pressure Class I, II, or III as required or indicated for the design system pressure. Impeller wheels shall be rigidly constructed, accurately balanced both statically and dynamically. Fan blades may be forward curved, backward-inclined or airfoil design in wheel sizes up to 750 mm (30 inches, or as indicated on the drawings. Fan blades for wheels over 750 mm (30 inches) in diameter shall be backward-inclined or airfoil design, or as indicated on the drawings. Booster fans for exhaust dryer systems shall be the open-wheel radial type. These fans shall be suitable for conveying lint and the temperatures encountered. The fan shaft shall be provided with a heat slinger to dissipate heat buildup along the shaft. An access (service) door to facilitate maintenance shall be supplied with these fans. Fan wheels over 900 mm (36 inches) in diameter shall have overhung pulleys and a bearing on each side of the wheel. Fan wheels 900 mm (36 inches) or less in diameter may have one or more extra long bearings between the fan wheel and the drive. Bearings shall be sleeve type, self-aligning and self-oiling with oil reservoirs, or precision self-aligning roller or ball-type with accessible grease fittings or permanently lubricated type. Grease fittings shall be connected to tubing and serviceable from a single accessible point. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Fan shafts shall be steel, accurately finished, and shall be provided with key seats and keys for impeller hubs and fan pulleys. Each fan outlet shall be of ample proportions and shall be designed for the attachment of angles and bolts for attaching flexible connections. Manually or automatically operated outlet dampers shall be provided as indicated. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have open, dripproof, or totally enclosed enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure. Remote manual switch with pilot indicating light shall be provided where indicated.

2.9.1.2 In-Line Centrifugal Fans

In-line fans shall have centrifugal backward inclined blades, stationary discharge conversion vanes, internal and external belt guards, and adjustable motor mounts. Fans shall be mounted in a welded tubular casing. Air shall enter and leave the fan axially. Inlets shall be streamlined with conversion vanes to eliminate turbulence and provide smooth discharge air flow. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt and shall be permanently lubricated, and shall be precision self aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Motors shall have open, dripproof, or totally enclosed enclosure. Motor starters shall be magnetic across-the-line with general-purpose enclosures. Remote manual switch with pilot indicating light shall be provided where indicated.

2.9.1.3 Axial Flow Fans

Axial flow fans shall be complete with drive components and belt guard, and shall have a steel housing, cast fan wheel, cast or welded steel diffusers, fan shaft, bearings, and mounting frame as a factory-assembled unit. Fan wheels shall have radially projecting blades of airfoil cross section and shall be dynamically balanced and keyed to the fan shaft. Fan bearings and drive shafts shall be enclosed and isolated from the air stream. Fan bearings shall be sealed against dust and dirt, shall be permanently lubricated or with accessible grease fittings, and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours of operation as defined by AFBMA Std 9 and AFBMA Std 11. Fan inlets shall be provided with an aerodynamically shaped bell and an inlet cone. Diffuser or straightening vanes shall be provided at the fan discharge to minimize turbulence and provide smooth discharge air flow. Fan unit shall be provided with inlet and outlet flanges, inlet screen, and automatic operation adjustable inlet vanes. Unless otherwise indicated, motors shall not

exceed 1800 rpm and shall have open, dripproof, or totally enclosed enclosure. Motor starters shall be magnetic across-the-line with general-purpose enclosure. Remote manual switch with pilot indicating light shall be provided where indicated.

2.9.1.4 Panel Type Power Wall Ventilators

Fans shall be propeller type, assembled on a reinforced metal panel with venturi opening spun into panel. Fans with wheels less than 600 mm (24 inches) diameter shall be direct or V-belt driven and fans with wheels 600 mm (24 inches) diameter and larger shall be V-belt drive type. Fans shall be furnished with wall mounting collar. Lubricated bearings shall be provided. Fans shall be fitted with wheel and motor side metal or wire guards which have a corrosion-resistant finish. Motor enclosure shall be dripproof, or totally enclosed fan cooled type. Gravity, or motor operated backdraft dampers shall be provided where and as indicated.

2.9.1.5 Centrifugal Type Power Wall Ventilators

Fans shall be direct or V-belt driven centrifugal type with backward inclined, non-overloading wheel. Motor housing shall be removable and weatherproof. Unit housing shall be designed for sealing to building surface and for discharge and condensate drippage away from building surface. Housing shall be constructed of heavy gauge aluminum. Unit shall be fitted with an aluminum or plated steel wire discharge bird screen, anodized aluminum, or stainless steel wall grille, manufacturer's standard gravity or motor-operated damper, an airtight and liquid-tight metallic wall sleeve. Motor enclosure shall be totally enclosed fan cooled, or dripproof type. Lubricated bearings shall be provided.

2.9.1.6 Centrifugal Type Power Roof Ventilators

Fans shall be direct or V-belt driven with backward inclined, non-overloading wheel. Motor compartment housing shall be hinged or removable and weatherproof, constructed of heavy gauge aluminum. Fans shall be provided with bird screen, disconnect switch, gravity or motorized dampers, sound curb, roof curb, and extended base as indicated or required. Motors enclosure shall be dripproof type. Lubricated bearings shall be provided.

2.9.1.7 Propeller Type Power Roof Ventilators

Fans shall be direct or V-belt driven. Fan housing shall be hinged or removable weathertight, fitted with framed rectangular base constructed of aluminum or galvanized steel. Motors shall be totally enclosed fan cooled type. Motors shall be provided with nonfusible, horsepower rated, manual disconnect mount on unit. Fans shall be provided with gravity or motor operated dampers, bird screen, sound curb, roof curb. Lubricated bearings shall be provided.

2.9.1.8 Ceiling Exhaust Fans

Suspended cabinet-type ceiling exhaust fans shall be centrifugal type, direct-driven. Fans shall have acoustically insulated housing. Integral backdraft damper shall be chatter-proof. The integral face grille shall be of egg-crate design or louver design. Fan motors shall be mounted on vibration isolators. Unit shall be provided with mounting flange for hanging unit from above. Fans shall be UL listed.

2.9.2 Coils

Coils shall be fin-and-tube type constructed of seamless copper tubes and aluminum or copper fins mechanically bonded or soldered to the tubes. Copper tube wall thickness shall be a minimum of 0.508 mm (0.020 inches). Aluminum fins shall be 0.19 mm (0.0075 inch) minimum thickness. Copper fins shall be 0.114 mm (0.0045 inch) minimum thickness. Casing and tube support sheets shall be not lighter than 1.6 mm (16 gauge) galvanized steel, formed to provide structural strength. When required, multiple tube supports shall be provided to prevent tube sag. Each coil shall be tested at the factory under water at not less than 2.76 MPa (400 psi) air pressure and shall be suitable for 1.38 MPa (200

psi) 200 psi working pressure. Coils shall be mounted for counterflow service. Coils shall be rated and certified according to ARI 410.

2.9.2.1 Water Coils

Water coils shall be installed with a pitch of not less than 10 mm per meter 1/8 inch per foot of the tube length toward the drain end. Headers shall be constructed of cast iron, welded steel or copper. Each coil shall be provided with a plugged vent and drain connection extending through the unit casing.

2.9.3 Air Filters

Air filters shall be listed according to requirements of UL 900, except high efficiency particulate air filters of 99.97 percent efficiency by the DOP Test method shall be as listed under the Label Service and shall meet the requirements of UL 586.

2.9.3.1 Extended Surface Pleated Panel Filters

Filters shall be 50 mm (2 inch) depth, sectional, disposable type of the size indicated and shall have an average efficiency of 25 to 30 percent when tested according to ASHRAE 52.1. Initial resistance at 2.54 m/s (500 feet per minute) shall not exceed 9 mm (0.36 inches) water gauge. Filters shall be UL Class 2. Media shall be nonwoven cotton and synthetic fiber mat. A wire support grid bonded to the media shall be attached to a moisture resistant fiberboard frame. All four edges of the filter media shall be bonded to the inside of the frame to prevent air bypass and increase rigidity.

2.9.3.2 Extended Surface Nonsupported Pocket Filters

Filters shall be 750 (30 inch) depth, sectional, replaceable dry media type of the size indicated and shall have an average efficiency of 80 to 85 percent when tested according to ASHRAE 52.1. Initial resistance at 2.54 m/s (500 feet per minute) shall not exceed 11 mm (0.45 inches) water gauge. Filters shall be UL Class 1. Media shall be fibrous glass, supported in the air stream by a wire or non-woven synthetic backing and secured to a galvanized steel metal header. Pockets shall not sag or flap at anticipated air flows. Each filter shall be installed with an extended surface pleated panel filter as a prefilter in a factory preassembled, side access housing or a factory-made sectional frame bank, as indicated.

2.9.3.3 Sectional Cleanable Filters

Cleanable filters shall conform to ASTM F 872, and shall be 25 1 inches thick. Viscous adhesive shall be provided in 20 liter (5 gallon) containers in sufficient quantity for 12 cleaning operations and not less than one liter (one quart) for each filter section. One washing and charging tank shall be provided for every 100 filter sections or fraction thereof. Each washing and charging unit shall consist of a tank and double drain rack mounted on legs. Drain rack shall be provided with dividers and partitions to properly support the filters in the draining position. Initial pressure drop for clean filters shall not exceed the applicable values listed in ASTM F 872.

2.9.3.4 Replaceable Media Filters

Replaceable media filters shall be the dry-media type, of the size required to suit the application. Filtering media shall be not less than 50 mm (2 inches) thick fibrous glass media pad supported by a structural wire grid or woven wire mesh. Pad shall be enclosed in a holding frame of not less than 1.6 mm (16 gauge) galvanized steel, and equipped with quick-opening mechanism for changing filter media. The air flow capacity of the filter shall be based on net filter face velocity not exceeding 1.5 m/s (300 feet per minute), with initial resistance of 32 Pa (0.13 inches water gauge). Average efficiency shall be not less than 35 percent when tested according to ASHRAE 52.1.

2.9.3.5 Range and Griddle Hood Service

Filter shall be sectional, permanent, washable, all metallic media type, nominal 50 mm (2 inches) thick, with suitable metal frames, designed for extraction of grease from grease-laden air.

2.9.3.6 Holding Frames

Frames shall be fabricated from not lighter than 1.6 mm (16 gauge) sheet steel with rust-inhibitor coating. Each holding frame shall be equipped with suitable filter holding devices. Holding frame seats shall be gasketed. All joints shall be airtight.

2.9.3.7 Filter Gauges

Filter gauges shall be dial type, diaphragm actuated draft and shall be provided for all filter stations, including those filters which are furnished as integral parts of factory fabricated air handling units. Gauges shall be at least 98 mm (3-7/8 inches) in diameter, shall have white dials with black figures, and shall be graduated in 0.0025 kPa mm (0.01 inch of water), and shall have a minimum range of 0.25 kPa (1 inch of water) beyond the specified final resistance for the filter bank on which each gauge is applied. Each gauge shall incorporate a screw operated zero adjustment and shall be furnished complete with two static pressure taps with integral compression fittings, two molded plastic vent valves, two 1.5 m (5 foot) minimum lengths of 6.35 mm (1/4 inch) diameter vinyl tubing, and all hardware and accessories for gauge mounting.

2.10 AIR HANDLING UNITS

2.10.1 Field-Fabricated Air Handling Units

Built-up units shall be as specified in paragraph DUCTWORK COMPONENTS. Fans, coils, and air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types indicated.

2.10.2 Factory-Fabricated Air Handling Units

Units shall be single-zone draw-through type or single-zone blow-through type or multizone blow-through type as indicated. Units shall include fans, coils, airtight insulated casing, prefilters, secondary filter sections, air blender adjustable V-belt drives, belt guards for externally mounted motors, access sections where indicated, mixing box, combination sectional filter-mixing box, vibration-isolators, and appurtenances required for specified operation. Vibration isolators shall be as indicated. Each air handling unit shall have physical dimensions suitable to fit space allotted to the unit and shall have the capacity indicated. Air handling unit shall have published ratings based on tests performed according to ARI 430.

2.10.2.1 Casings

Casing sections shall be single wall type unless otherwise indicated, constructed of a minimum 18 gauge galvanized steel, or 18 gauge steel outer casing protected with a corrosion resistant paint finish according to paragraph FACTORY PAINTING. Inner casing of double-wall units shall be minimum 1.0 mm (20 gauge) solid galvanized steel. Casing shall be designed and constructed with an integral structural steel frame such that exterior panels are non-load bearing. Exterior panels shall be individually removable. Removal shall not affect the structural integrity of the unit. Casings shall be provided with inspection doors, access sections, and access doors as indicated. Inspection and access doors shall be insulated, fully gasketed, double-wall type, of a minimum 1.3 mm (18 gauge) outer and 1.0 mm (20 gauge) inner panels. Doors shall be rigid and provided with heavy duty hinges and latches. Inspection doors shall be a minimum 300 mm (12 inches) wide by 300 mm (12 inches) high. Access doors shall be minimum 600 mm (24 inches) wide and shall be the full height of the unit casing or a minimum of 1800 mm (6 ft), whichever is less. Access Sections shall be according to paragraph AIR HANDLING UNITS. Drain pan shall be double-bottom type constructed of 16 gauge

stainless steel, pitched to the drain connection. Drain pans shall be constructed water tight, treated to prevent corrosion, and designed for positive condensate drainage. When 2 or more heat exchange coils are used, with one stacked above the other, condensate from the upper coils shall not flow across the face of lower coils. Intermediate drain pans or condensate collection channels and downspouts shall be provided, as required to carry condensate to the unit drain pan out of the air stream and without moisture carryover. Each casing section handling conditioned air shall be insulated with not less than 25 mm (1 inch), 24 kg per cubic meter (1-1/2 pound density) coated fibrous glass material having a thermal conductivity not greater than 0.033 W/m-K (0.23 Btu/hr-sf-F). Factory applied fibrous glass insulation shall conform to ASTM C 1071, except that the minimum thickness and density requirements do not apply, and shall meet the requirements of NFPA 90A. Foam-type insulation is not acceptable. Foil-faced insulation shall not be an acceptable substitute for use on double-wall access doors and inspections doors and casing sections. Duct liner material, coating, and adhesive shall conform to fire-hazard requirements specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Exposed insulation edges and joints where insulation panels are butted together shall be protected with a metal nosing strip or shall be coated to conform to meet erosion resistance requirements of ASTM C 1071. A latched and hinged inspection door, shall be provided in the fan and coil sections. Additional inspection doors, access doors and access sections shall be provided where indicated.

2.10.2.2 Heating Coils

Coils shall be provided as specified in paragraph AIR SYSTEMS EQUIPMENT, for types indicated.

2.10.2.3 Air Filters

Air filters shall be as specified in paragraph AIR SYSTEMS EQUIPMENT for types and thickness indicated.

2.10.2.4 Fans

Fans shall be double-inlet, centrifugal type with each fan in a separate scroll. Fans and shafts shall be dynamically balanced prior to installation into air handling unit, then the entire fan assembly shall be statically and dynamically balanced at the factory after it has been installed in the air handling unit. Fans shall be mounted on steel shafts accurately ground and finished. Fan bearings shall be sealed against dust and dirt and shall be precision self-aligning ball or roller type. Bearing life shall be L50 rated at not less than 200,000 hours as defined by AFBMA Std 9 and AFBMA Std 11. Bearings shall be permanently lubricated or lubricated type with lubrication fittings readily accessible at the drive side of the unit. Bearings shall be supported by structural shapes, or die formed sheet structural members, or support plates securely attached to the unit casing. Bearings may not be fastened directly to the unit sheet metal casing. Fans and scrolls shall be furnished with coating indicated. Fans shall be driven by a unit-mounted or a floor-mounted motor connected to fans by V-belt drive complete with belt guard for externally mounted motors. Belt guards shall be the three sided enclosed type with solid or expanded metal face. Belt drives shall be designed for not less than a 1.3 service factor based on motor nameplate rating. Motor sheaves shall be variable pitch for 20 kW (25 hp) and below and fixed pitch above 20 kW (25 hp) as defined by ARI Guideline D. Where fixed sheaves are required, variable pitch sheaves may be used during air balance, but shall be replaced with an appropriate fixed sheave after air balance is completed. Variable pitch sheaves shall be selected to drive the fan at a speed that will produce the specified capacity when set at the approximate midpoint of the sheave adjustment. Motors for V-belt drives shall be provided with adjustable bases. Fan motors shall have open enclosures. Motor starters shall be magnetic across-the-line type with general-purpose enclosure. Unit fan or fans shall be selected to produce the required capacity at the fan static pressure. Sound power level shall be as indicated. The sound power level values shall be obtained according to AMCA 300 or ASHRAE 68.

2.10.2.5 Access Sections and Filter/Mixing Boxes

Access sections shall be provided where indicated and shall be furnished with access doors as shown. Access sections and filter/mixing boxes shall be constructed in a manner identical to the remainder of the unit casing and shall be equipped with access doors. Mixing boxes shall be designed to minimize air stratification and to promote thorough mixing of the air streams.

2.10.2.6 Dampers

Dampers shall be as specified in paragraph CONTROLS.

2.11 TERMINAL UNITS

2.11.1 Ducted and Room Fan-Coil Units

Base units shall include galvanized coil casing, coil assembly drain pan valve and piping package (external for ducted fan coil units), outside air damper, wall intake box (where indicated), air filter, fans, motor, fan drive, and motor switch, plus an enclosure for cabinet models and casing for concealed models. Leveling devices integral with the unit shall be provided for vertical type non-ducted units. Sound power levels shall be as indicated. Sound power level data or values for these units shall be obtained according to test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles. Values obtained for the standard cabinet models will be acceptable for concealed models without separate test provided there is no variation between models as to the coil configuration, blowers, motor speeds, or relative arrangement of parts. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Each unit shall be fastened securely to the building structure. Capacity of the units shall be as indicated. Room fan-coil units shall be certified as complying with ARI 440, and shall meet the requirements of UL 1995.

2.11.1.1 Enclosures of Room Fan Coil Units

Enclosures shall be fabricated of not lighter than 1.3 mm (18 gauge) steel, reinforced and braced. Front panels of enclosures shall be removable and provided with 13 mm (1/2 inch) thick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 23 m/s (4,500 fpm). Discharge grille shall be integrally stamped and shall be of such design as to properly distribute air throughout the conditioned space. Plastic discharge and return grilles are acceptable provided the plastic material is certified by the manufacturer to be classified as flame resistant according to UL 94 and the material shall comply with the heat deflection criteria specified in UL 1995. Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access doors or removable panels shall be provided for piping and control compartments. Duct discharge collar shall be provided for concealed models. Enclosures shall have easy access for filter replacement.

2.11.1.2 Enclosures of Ducted Fan Coil Units

Enclosures shall be fabricated of not lighter than 1.3 mm (18 gauge) steel, reinforced and braced. Front panels of enclosures shall be removable and provided with 13 mm (1/2 inch) thick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 23 m/s (4,500 fpm). Ferrous metal surfaces shall be galvanized or factory finished with corrosion resistant enamel. Access doors or removable panels shall be provided for piping and control compartments. Duct discharge collar shall be provided for concealed models. Mixing box bases shall be provided with return and outside air dampers accessible for ease of balancing. Vertical units concealed in closets shall be upflow type with the combined return and fresh inlet at the bottom of the unit. Enclosures shall have easy access for filter. A filter section may be provided with the mixing box base for ease of access for filter replacement.

2.11.1.3 Fans

Fans shall be galvanized steel or aluminum, multiblade, centrifugal type. In lieu of metal, fans and scrolls may be non-metallic materials of suitably reinforced compounds. Fans shall be dynamically and statically balanced. Surfaces shall be smooth. Assemblies shall be accessible for maintenance. Disassembly and re-assembly shall be by means of mechanical fastening devices and not by epoxies or cements.

2.11.1.4 Coils

Coils shall be constructed of not less than 10 mm (3/8 inch) outside diameter seamless copper tubing, with copper or aluminum fins mechanically bonded or soldered to the tubes. Coils shall be provided with not less than 12 mm (1/2 inch) outside diameter flare or sweat connectors, accessory piping package with thermal connections suitable for connection to the type of control valve supplied, and manual air vent. Coils shall be tested hydrostatically at 2000 kPa (300 psi) or under water at 1700 kPa (250 psi) air pressure and suitable for 1400 kPa (200 psi) working pressure. Provisions shall be made for coil removal.

2.11.1.5 Drain Pans

Where condensation is possible, drain and drip pans shall be sized and located to collect all water condensed on and dripping from any item within the unit enclosure or casing. Drain pans shall be constructed of not lighter than 0.9 mm (21 gauge) steel, galvanized after fabrication, thermally insulated to prevent condensation. Insulation shall have a flame spread rating not over 25 without evidence of continued progressive combustion, a smoke developed rating no higher than 50, and shall be of a waterproof type or coated with a waterproofing material. In lieu of the above, drain pans may be constructed of die-formed 0.85 mm (22 gauge) steel, formed from a single sheet, galvanized after fabrication, insulated and coated as specified for the 0.9 mm (21 gauge) material or of die-formed 0.9 mm (21 gauge) type 304 stainless steel, insulated as specified above. Drain pans shall be pitched to drain. Minimum 20 mm (3/4 inch) NPT or 15 mm (5/8 inch) OD drain connection shall be provided in drain pan. Auxiliary drain pans to catch drips from control and piping packages, eliminating insulation of the packages, may be plastic; if metal, the auxiliary pans shall comply with the requirements specified above. Insulation at control and piping connections thereto shall extend 25 mm (1 inch) minimum over the auxiliary drain pan.

2.11.1.5 Manually Operated Outside Air Dampers

Manually operated outside air dampers shall be provided according to the arrangement indicated. Dampers shall be parallel airfoil type and of galvanized construction. Blades shall rotate on stainless steel or nylon sleeve bearings.

2.11.1.6 Filters

Filters shall be of the fiberglass disposable type, 25 mm (1 inch) thick, conforming to CID A-A-1419. Filters in each unit shall be removable without the use of tools.

2.11.1.7 Motors

Motors shall be of the permanent split-capacitor type with built-in thermal overload protection, directly connected to unit fans. Motor switch shall be two or three speeds and off, manually operated, and shall be mounted on an identified plate inside the unit below or behind an access door for room units or adjacent to the unit in the closet for ducted units, or if indicated, adjacent to the room thermostat. In lieu of the above fan speed control, a solid-state variable-speed controller having a minimum speed reduction of 50 percent may be provided. Motors shall have permanently-lubricated or oilable sleeve-type or combination ball and sleeve-type bearings with vibration isolating mountings suitable for

continuous duty. Motor power consumption, shown in watts, at the fan operating speed selected to meet the specified capacity shall not exceed the following values:

Free Discharge Motors

Unit Capacity (LS)	Maximum Power Consumption (Watts)		
	115V	230V	277V
94	70	110	90
142	100	110	110
189	170	150	150
283	180	210	220
378	240	240	230
472	310	250	270
566	440	400	440

Free Discharge Motors

Unit Capacity (cfm)	Maximum Power Consumption (Watts)		
	115V	230V	277V
200	70	110	90
300	100	110	110
400	170	150	150
600	180	210	220
800	240	240	230
1000	310	250	270
1200	440	400	440

High Static Motors

Unit Capacity (L/S)	Maximum Power Consumption (Watts)
94	145
142	145
189	210
283	320
378	320
472	530
566	530

High Static Motors

Unit Capacity (cfm)	Maximum Power Consumption (Watts)
200	145
300	145
400	210
600	320
800	320
1000	530
1200	530

2.11.2 Variable Air Volume (VAV) and Dual Duct Terminal Units

VAV and dual duct terminal units shall be the type, size, and capacity shown and shall be mounted in the ceiling or wall cavity and shall be suitable for single or dual duct system applications. Actuators and controls shall be as specified in paragraph CONTROLS. Unit enclosures shall be constructed of galvanized steel not lighter than 0.85 mm (22 gauge) or aluminum sheet not lighter than 1.3 mm (18 gauge). Single or multiple discharge outlets shall be provided as required. Units with flow limiters are not acceptable. Unit air volume shall be factory preset and readily field adjustable without special tools. Reheat coils shall be provided as indicated. A flow chart shall be attached to each unit. Acoustic performance of the terminal units shall be based upon units tested according to ARI 880. Sound power level shall be as indicated. Discharge sound power shall be shown for minimum and 375 Pa (1-1/2 inches water gauge) inches water gauge inlet static pressure. Acoustical lining shall be according to NFPA 90A.

2.11.2.1 Constant Volume, Single Duct

Constant volume, single duct, terminal units shall contain within the casing, a mechanical or pneumatic constant volume regulator. Volume regulators shall control air delivery to within plus or minus 5 percent of specified air flow subjected to inlet pressure from 200 to 1500 Pa (3/4 to 6 inch water gauge).

2.11.2.2 Variable Volume, Single Duct

Variable volume, single duct, terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, and accessory relays. Units shall control air volume to within plus or minus 5 percent of each air set point volume as determined by the thermostat with variations in inlet pressures from 200 to 1500 Pa (3/4 to 6 inch water gauge). Internal resistance of units shall not exceed 100 Pa (0.4 inch water gauge) at maximum flow range. External differential pressure taps separate from the control pressure taps shall be provided for air flow measurement with a 0 to 250 Pa (0 to 1 inch water gauge) range. Unit volume controller shall be normally open upon loss of power.

2.11.2.3 Variable Volume, Single Duct, Fan-Powered

Variable volume, single duct, fan-powered terminal units shall be provided with a calibrated air volume sensing device, air valve or damper, actuator, fan and motor, and accessory relays. Units shall control primary air volume to within plus or minus 5 percent of each air set point as determined by the thermostat with variations in inlet pressure from 200 to 1500 Pa (3/4 to 6 inch water gauge). Unit fan shall be centrifugal, direct-driven, double-inlet type with forward curved blades. Fan motor shall be either single speed with speed controller or three-speed, permanently lubricated, permanent split-capacitor type. Fan/motor assembly shall be isolated from the casing to minimize vibration transmission. Fan control shall be factory furnished and wired into the unit control system. A factory-mounted pressure switch shall be furnished to operate the unit fan whenever pressure exists at the unit primary air inlet or when the control system fan operates.

2.11.2.6 Reheat Units

- a. Hot Water Coils: Hot-water coils shall be fin-and-tube type constructed of seamless copper tubes and copper or aluminum fins mechanically bonded or soldered to the tubes. Headers shall be constructed of cast iron, welded steel or copper. Casing and tube support sheets shall be 1.6 mm (16 gauge), galvanized steel, formed to provide structural strength. Tubes shall be correctly circuited for proper water velocity without excessive pressure drop and they shall be drainable where required or indicated. At the factory, each coil shall be tested at not less than 1700 kPa (250 psi) air pressure and shall be suitable for 1400 kPa (200 psi) working pressure. Drainable coils shall be installed in the air handling units with a pitch of not less than 10 mm per m (1/8 inch per foot) of tube length toward the drain end. Coils shall conform to the provisions of ARI 410.

2.11.4 Unit Ventilators

Unit ventilators shall include an enclosure, galvanized casing, or cold-rolled steel casing with corrosion resistant coating, coil assembly, valve and piping package, drain pan, air filters, fan assembly, fan drive, motor, motor controller, dampers, and damper operators. Sound power level shall be as indicated. Sound power level data or values for these units shall be obtained according to test procedures based on ARI 350. Sound power values apply to units provided with factory fabricated cabinet enclosures and standard grilles, when handling standard flow for which the unit air capacity is rated. Each unit shall be secured to the building structure. Capacity of the unit ventilators shall be as indicated. Unit ventilators shall be of the year-round classroom type with automatic controls arranged to properly heat and ventilate the room. Automatic valves and controls shall be provided as specified in paragraph CONTROLS. Sequence of control shall be any one of the standard ANSI cycles specified in paragraph CONTROLS.

2.11.4.1 Enclosures

Enclosures shall be fabricated of not lighter than 1.6 mm (16 gauge) galvanized steel, reinforced and braced, or all welded framework with panels to provide equivalent strength. The casing shall be acoustically and thermally insulated internally with not less than 13 mm (1/2 inch) thick dual density fibrous glass insulation. The exposed side shall be high density, erosion-proof material suitable for use in air streams with velocities up to 246 m/s (4500 fpm). The insulation shall be fastened with waterproof, fire-resistant adhesive. Front panel shall be designed for easy removal by one person. Discharge grilles shall have adjustable grilles or grilles with adjustable vanes and shall properly distribute air throughout the conditioned space. Return grilles shall be removable where front panel does not provide access to interior components. Plastic discharge or return grilles are not acceptable. Removable panels or access doors shall be provided for all piping and control compartments. Fan switch shall be key operated or accessible through a locked access panel. Gaskets shall be provided at the back and bottom of the unit for effective air seal, as required.

2.11.4.2 Fans

Fans shall be of the galvanized steel or aluminum, multiblade, centrifugal type, dynamically and statically balanced. Fan housings shall be provided with resilient mounted, self-aligning permanently lubricated ball bearings, sleeve bearings, or combination ball and sleeve bearings, capable of not less than 2000 hours of operation on one oiling. Fans shall be direct-connected.

2.11.4.3 Coils

Coils shall be circuited for a maximum water velocity of 2.4 m/s (8 fps) without excessive pressure drop and shall otherwise be as specified for hot water coils in paragraph TERMINAL UNITS.

2.11.4.4 Drain Pans

Drain and drip pans shall be sized and located to collect all condensed water dripping from any item within the unit enclosure. Drain pans shall be constructed of not lighter than 1.2 mm (18 gauge) steel, galvanized after fabrication, and thermally insulated to prevent condensation. Insulation shall be coated with a fire-resistant waterproofing material. In lieu of the above, drain pans may be constructed of die-formed 1.0 mm (20 gauge) steel, formed from a single sheet and galvanized after fabrication and insulated and coated as for the 1.2 mm (18 gauge) steel material, or of die-formed 1.3 mm (18 gauge) type 304 stainless steel insulated as specified above. Drain pans shall be pitched to drain. Drain connection shall be provided when a condensate drain system is indicated. Connection shall be minimum 20 mm (3/4 inch) NDT or 18 mm (5/8 inch) OD.

2.11.4.5 Filters

Fiberglass disposable type, 25 mm (1 inch) thick, conforming to CID A-A-1419, installed upstream of coil.

2.11.4.6 Dampers

An outside air proportioning damper shall be provided on each unit. In addition, a vane shall be provided to prevent excessive outside air from entering unit and to prevent blow-through of outside air through the return air grille under high wind pressures. Where outside air and recirculated air proportioning dampers are provided on the unit, an additional vane will not be required. Face and bypass dampers shall be provided for each unit to ensure constant air volume at all positions of the dampers. Each unit shall be provided with a factory installed control cam assembly, electric motor to operate the face and bypass dampers and outside air damper or outside air and recirculated air dampers in the sequence as specified in paragraph CONTROLS.

2.11.4.7 Motors

Motors shall be of the permanent split-capacitor type with built-in thermal overload protection and automatic reset. Motor shall be mounted on a resilient mounting, isolated from the casing and shall be suitable for operation on electric service available. A manually operated motor switch shall provide for 2 or 3 speeds and off and shall be mounted on an identified plate inside the unit below or behind an access door or adjacent to the room thermostat as indicated. In lieu of speed control, a solid state variable speed controller having minimum speed reduction of 50 percent may be provided.

2.11.4.8 Outside Air Intakes

Outside air intakes shall be the manufacturer's standard design and provided with 13 mm (1/2 inch) mesh bird screen or louvers on 13 mm (1/2 inch) centers.

2.12 ENERGY RECOVERY DEVICES

2.12.1 Rotary Wheel

Unit shall be a factory fabricated and tested assembly for air-to-air energy recovery by transfer of sensible heat from exhaust air to supply air stream. Device performance shall be according to ASHRAE 84. Device shall deliver an energy transfer effectiveness of not less than 70 percent with cross-contamination not in excess of 0.1 percent of exhaust airflow rate at system design differential pressure, including purging sector if provided with wheel. Exchange media shall be chemically inert, moisture-resistant, fire-retardant, laminated, nonmetallic material which complies with NFPA 90A. Exhaust and supply streams shall be isolated by seals which are static, field adjustable, and replaceable. Chain drive mechanisms shall be fitted with ratcheting torque limiter or slip-clutch protective device. Enclosure shall be fabricated from galvanized steel and shall include maintenance access provisions. Recovery control and rotation failure provisions shall be as indicated.

2.12.2 Heat Pipe

Device shall be a factory fabricated, assembled and tested, counterflow arrangement, air-to-air heat exchanger for transfer of sensible heat between exhaust and supply streams. Device shall deliver an energy transfer effectiveness not less than that indicated without cross-contamination. Heat exchanger tube core shall be 15, 18, or 25 mm (1/2, 5/8, 1 inch) nominal diameter, seamless aluminum or copper tube with extended surfaces, utilizing wrought aluminum Alloy 3003 or Alloy 5052, temper to suit. Maximum fins per unit length and number of tube rows shall be as indicated. Tubes shall be fitted with internal capillary wick, filled with an ASHRAE 15, Group 1 refrigerant working fluid, selected for system design temperature range, and hermetically sealed. Heat exchanger frame shall be constructed of not less than 1.6 mm (16 gauge) galvanized steel and fitted with intermediate tube supports, and flange

connections. Tube end-covers and a partition of galvanized steel to separate exhaust and supply air streams without cross-contamination and in required area ratio shall be provided. A drain pan constructed of welded Type 300 series stainless steel shall be provided. Heat recovery regulation shall be provided by system face and bypass dampers and related control system as indicated. Coil shall be fitted with pleated flexible connectors.

2.12.3 Drain Pans

Drain and drip pans shall be sized and located to collect all condensed water dripping from any item within the unit enclosure. Drain pans shall be constructed of not lighter than 1.3 mm (18 gauge) Type 304 series stainless steel, and thermally insulated to prevent condensation. Insulation in the attic space shall be non-combustible, and shall be covered with a non-combustible waterproofing material. Drain pans shall be pitched to drain. Drain connection shall be provided to the sanitary waste through the use of an indirect waste fitting. Connection shall be minimum 20 mm (3/4 inch) NDT or 18 mm (5/8 inch) OD.

2.13 FACTORY PAINTING

Units which are not of galvanized construction according to ASTM A 123/A 123M or ASTM A 924/A 924M shall be factory painted with a corrosion resisting paint finish. Internal and external ferrous metal surfaces shall be cleaned, phosphatized and coated with a paint finish which has been tested according to ASTM B 117, ASTM D 1654, and ASTM D 3359. Evidence of satisfactory paint performance for a minimum of 125 hours for units to be installed indoors and 500 hours for units to be installed outdoors shall be submitted. Rating of failure at the scribe mark shall be not less than 6, average creepage not greater than 3 mm (1/8 inch). Rating of the inscribed area shall not be less than 10, no failure. On units constructed of galvanized steel which have been welded, exterior surfaces of welds or welds that have burned through from the interior shall receive a final shop docket of zinc-rich protective paint according to ASTM D 520 Type I.

PART 3 EXECUTION

3.1 INSTALLATION

Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

3.1.1 Piping

Pipe and fitting installation shall conform to the requirements of ASME B31.1. Pipe shall be cut accurately to measurements established at the jobsite, and worked into place without springing or forcing, completely clearing all windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted without written approval. Pipe or tubing shall be cut square, shall have burrs removed by reaming, and shall permit free expansion and contraction without causing damage to the building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 100 mm (4 inches) and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Horizontal supply mains shall pitch down in the direction of flow as indicated. The grade shall be not less than 2 mm in 1 m (1 inch in 40 feet). Reducing fittings shall be used for changes in pipe sizes. Open ends of pipelines and equipment shall be capped or plugged during installation to keep dirt or other foreign materials out of the system. Pipe not otherwise specified shall be uncoated. Connections to appliances shall be made with malleable iron unions for steel pipe 65 mm (2-1/2 inches) or less in diameter, and with flanges for pipe 80 mm (3 inches) and larger. Connections between ferrous and copper piping shall be electrically isolated from each other with dielectric unions or flanges. All piping located in air plenums shall conform to NFPA 90A

requirements. Pipe and fittings installed in inaccessible conduits or trenches under concrete floor slabs shall be welded.

3.1.1.1 Joints

- a. Threaded Joints: Threaded joints shall be made with tapered threads and made tight with a stiff mixture of graphite and oil or polytetrafluoroethylene tape or equivalent thread joint compound or material, applied to the male threads only.
- b. Soldered Joints: Joints in copper tubing shall be cut square with ends reamed, and all filings and dust wiped from interior of pipe. Joints shall be soldered with 95/5 solder or brazed with silver solder applied and drawn through the full fitting length. Care shall be taken to prevent annealing of tube or fittings when making connections. Joints 65 mm (2-1/2 inches) and larger shall be made with heat uniformly around the entire circumference of the joint with a multi-flame torch. Connections in floor slabs shall be brazed. Excess solder shall be wiped from joint before solder hardens. Solder flux shall be liquid or paste form, non-corrosive and conform to ASTM B 813.
- c. Welded Joints: Welding shall be according to qualified procedures using qualified welders and welding operators. Procedures and welders shall be qualified according to ASME BPV IX. Welding procedures qualified by others and welders and welding operators qualified by another operator may be permitted by ASME B31.1. Structural members shall be welded according to Section 05090 WELDING, STRUCTURAL. All welds shall be permanently identified by imprinting the welder's or welding operator's assigned symbol adjacent to the weld. Welded joints shall be fusion welded unless otherwise required. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connections may be made with either welding tees or branch outlet fittings. Branch outlet fittings shall be forged, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. Electrodes shall be stored and dried according to AWS D1.1 or as recommended by the manufacturer. Electrodes that have been wetted or that have lost any of their coating shall not be used.

3.1.1.2 Grooved Mechanical Joints

Grooves shall be prepared according to the coupling manufacturer's instructions. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no-go" gauge, vernier or dial caliper, or narrow-land micrometer. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.1.1.3 Flanges and Unions

Except where copper tubing is used, union or flanged joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.1.2 Supports

3.1.2.1 General

Hangers used to support piping 50 mm (2 inches) and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to

keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers.

3.1.2.2 Seismic Requirements (Pipe Supports and Structural Bracing)

Piping and attached valves shall be supported and braced to resist seismic loads as specified under Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided under this section. Material used for support shall be as specified under Section 05210 STEEL JOISTS.

3.1.2.3 Pipe Hangers, Inserts and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein. Types 5, 12, and 26 shall not be used.

- a. Hangers: Type 3 shall not be used on insulated piping.
- b. Inserts: Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.
- c. C-Clamps: Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- d. Angle Attachments: Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- e. Hangers: Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- f. Type 39 saddles shall be used on all insulated pipe 100 mm (4 inches) and larger when the temperature of the medium is above 15.5 degrees C (60 degrees F). Type 39 saddles shall be welded to the pipe.
- g. Type 40 shields shall:
 - (1) be used on all insulated pipes less than 100 mm (4 inches).
 - (2) be used on all insulated pipes 100 mm (4 inches) and larger when the temperature of the medium is 15.5 degrees C (60 degrees F) or less.
 - (3) have a high density insert for pipe 50 mm (2 inches) and larger, and for smaller pipe when the insulation shows signs of being visibly compressed, or when the insulation or jacket shows visible signs of distortion at or near the type 40 shield. High density inserts shall have a density of 144 kg/cubic meter (9 pcf) or greater.
- h. Horizontal Pipe Supports: Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm (1 foot) from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m (5 feet) apart at valves. Pipe hanger loads suspended from steel joist with hanger loads between panel points in excess of 220 N (50 pounds) shall have the excess hanger loads suspended from panel points.

- i. Vertical Pipe Supports: Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 5 m 15 feet, not more than 2.4 m (8 feet) from end of risers, and at vent terminations.
- j. Pipe Guides: Type 35 guides using steel reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided where required to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.
- k. Steel Slides: Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 100 mm (4 inches) and larger with medium 15.5 degrees C (60 degrees F) or greater, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 100 mm (4 inches), a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.
- l. High Temperature Guides with Cradles: Where there are high system temperatures and welding to piping is not desirable, the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm (4 inches), or by an amount adequate for the insulation, whichever is greater.
- m. Insulated Pipe: Insulation on horizontal pipe shall be continuous through hangers for hot and cold piping. Other requirements on insulated pipe are specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.3 Anchors

Anchors shall be provided wherever necessary or indicated to localize expansion or to prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.1.4 Pipe Sleeves

Sleeves shall not be installed in structural members except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Unless otherwise indicated, sleeves shall provide a minimum of 6 mm (1/4 inch) all-around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floors, and wet areas shall be steel pipe or cast iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast iron pipe, galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated, or moisture resistant fiber or plastic. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve, in non-fire rated walls, shall be sealed as indicated and specified in Section 07900 JOINT SEALING. Pipes passing through wall waterproofing membrane shall be sleeved as specified above, and a waterproofing clamping flange shall be installed as indicated.

3.1.4.1 Roof and Floor Sleeves

Pipes passing through roof or floor waterproofing membrane shall be installed through a 17-ounce copper sleeve or a 0.8 mm (0.032 inch) thick aluminum sleeve, each within an integral skirt or flange. Flashing sleeve shall be suitably formed, and skirt or flange shall extend not less than 200 mm 8 inches from the pipe and shall be set over the roof or floor membrane in a trowelled coating of

bituminous cement. Unless otherwise shown, the flashing sleeve shall extend up the pipe a minimum of 50 mm (2 inches) above highest floor level or a minimum of 250 mm (10 inches) above the roof. The annular space between the flashing sleeve and the bare pipe or between the flashing sleeve and the metal-jacket-covered insulation shall be sealed as indicated. Pipes up to and including 250 mm (10 inches) in diameter passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing clamp device, and pressure ring with brass bolts. Waterproofing membrane shall be clamped into place and sealant shall be placed in the caulking recess. In lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve or conduit and sleeve, a modular mechanical type sealing assembly may be installed. Seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe/conduit and sleeve with corrosion protected carbon steel bolts, nuts, and pressure plates. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe/conduit and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe/conduit and sleeve involved.

3.1.4.2 Fire Seal

Where pipes pass through firewalls, fire partitions, or floors, a fire seal shall be provided as specified in Section 07840 FIRESTOPPING.

3.1.4.3 Escutcheons

Escutcheons shall be provided at finished surfaces where exposed piping, bare or insulated, passes through floors, walls, or ceilings except in boiler, utility, or equipment rooms. Where sleeves project slightly from floors, special deep-type escutcheons shall be used. Escutcheons shall be secured to pipe or pipe covering.

3.1.5 Condensate Drain Lines

Water seals shall be provided in the condensate drain from all units. The depth of each seal shall be 50 mm (2 inches) plus 0.1 mm for each Pa, (the number of inches, measured in water gauge) of the total static pressure rating of the unit to which the drain is connected. Water seals shall be constructed of 2 tees and an appropriate U-bend with the open end of each tee plugged. Pipe cap or plug cleanouts shall be provided where indicated. Drains indicated to connect to the sanitary waste system shall be connected by an indirect waste fitting. Air conditioner drain lines shall be insulated as specified in Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

3.1.6 Pipe-Alignment Guides

Pipe-alignment guides shall be provided where indicated for expansion loops, offsets, and bends and as recommended by the manufacturer for expansion joints, not to exceed 1.5 m 5 feet on each side of each expansion joint, and in lines 100 mm (4 inches) 4 inches or smaller not more than 600 mm (2 feet) on each side of the joint.

3.1.7 Air Vents and Drains

3.1.7.1 Vents

Air vents shall be provided at high points, on water coils, and where indicated to ensure adequate venting of the piping system.

3.1.7.2 Drains

Drains shall be provided at low points and where indicated to ensure complete drainage of the piping. Drains shall be accessible, and shall consist of nipples and caps or plugged tees unless otherwise indicated.

3.1.8 Valves

Isolation gate or ball valves shall be installed on each side of each piece of equipment such as pumps, heaters, heating or cooling coils, and other similar items, at the midpoint of all looped mains, and at any other points indicated or required for draining, isolating, or sectionalizing purposes. Isolation valves may be omitted where balancing cocks are installed to provide both balancing and isolation functions. Each valve except check valves shall be identified. Valves in horizontal lines shall be installed with stems horizontal or above.

3.1.9 Equipment and Installation

Frames and supports shall be provided for tanks, compressors, pumps, valves, air handling units, fans, coils, dampers, and other similar items requiring supports. Air handling units shall be floor mounted or ceiling hung, as indicated. The method of anchoring and fastening shall be as detailed. Floor-mounted equipment, unless otherwise indicated, shall be set on not less than 150 mm (6 inch) 6 inch concrete pads or curbs doweled in place. Concrete foundations for circulating pumps shall be heavy enough to minimize the intensity of the vibrations transmitted to the piping and the surrounding structure, as recommended in writing by the pump manufacturer. In lieu of a concrete pad foundation, a concrete pedestal block with isolators placed between the pedestal block and the floor may be provided. The concrete foundation or concrete pedestal block shall be of a mass not less than three times the weight of the components to be supported. Lines connected to the pump mounted on pedestal blocks shall be provided with flexible connectors. Foundation drawings, bolt-setting information, and foundation bolts shall be furnished prior to concrete foundation construction for all equipment indicated or required to have concrete foundations. Concrete for foundations shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.10 Access Panels

Access panels shall be provided for concealed valves, vents, controls, dampers, and items requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced and maintained or completely removed and replaced. Access panels shall be as specified in Section 05500 MISCELLANEOUS METALS.

3.1.11 Flexible Connectors

Pre-insulated flexible connectors and flexible duct shall be attached to other components in accordance with the latest printed instructions of the manufacturer to ensure a vapor tight joint. Hangers, when required to suspend the connectors, shall be of the type recommended by the connector or duct manufacturer and shall be provided at the intervals recommended.

3.1.12 Sleeved and Framed Openings

Space between the sleeved or framed opening and the duct or the duct insulation shall be packed as specified in Section 07840 FIRESTOPPING for fire rated penetrations. For non-fire rated penetrations, the space shall be packed as specified in Section 07900 JOINT SEALING.

3.1.13 Metal Ductwork

Installation shall be according to SMACNA HVAC Duct Const Stds unless otherwise indicated. Duct supports for sheet metal ductwork shall be according to SMACNA HVAC Duct Const Stds, unless

otherwise specified. Friction beam clamps indicated in SMACNA HVAC Duct Const Stds shall not be used. Risers on high velocity ducts shall be anchored in the center of the vertical run to allow ends of riser to move due to thermal expansion. Supports on the risers shall allow free vertical movement of the duct. Supports shall be attached only to structural framing members and concrete slabs. Supports shall not be anchored to metal decking unless a means is provided and approved for preventing the anchor from puncturing the metal decking. Where supports are required between structural framing members, suitable intermediate metal framing shall be provided. Where C-clamps are used, retainer clips shall be provided.

3.1.15 FRP Ductwork

Fibrous glass reinforced plastic ducting and related structures shall conform to SMACNA Industry Practice. Flanged joints shall be provided where indicated. Crevice-free butt lay-up joints are acceptable where flanged joints are not indicated. When ambient temperatures are lower than 10 degrees C (50 degrees F), joints shall be heat cured by exothermic reaction heat packs.

3.1.16 Concealed Ducts Conveying Moisture Laden Air

Concealed ducts conveying moisture laden air shall be fabricated from minimum 1.3 mm (18 gauge), Type 300 series, stainless steel. Joints shall be continuously welded, brazed, or soldered to be liquid tight. Duct shall be pitched to drain at points indicated. Transitions to other metals shall be liquid tight, companion angle bolted and gasketed.

3.1.17 Acoustical Duct Lining

Lining shall be applied in cut-to-size pieces attached to the interior of the duct with nonflammable fire resistant adhesive conforming to ASTM C 916, Type I, NFPA 90A, UL 723, and ASTM E 84. Top and bottom pieces shall lap the side pieces and shall be secured with welded pins, adhered clips of metal, nylon, or high impact plastic, and speed washers or welding cup-head pins installed according to SMACNA HVAC Duct Const Stds. Welded pins, cup-head pins, or adhered clips shall not distort the duct, burn through, nor mar the finish or the surface of the duct. Pins and washers shall be flush with the surfaces of the duct liner and all breaks and punctures of the duct liner coating shall be sealed with the nonflammable, fire resistant adhesive. Exposed edges of the liner at the duct ends and at other joints where the lining will be subject to erosion shall be coated with a heavy brush coat of the nonflammable, fire resistant adhesive, to prevent delamination of glass fibers. Duct liner may be applied to flat sheet metal prior to forming duct through the sheet metal brake. Lining at the top and bottom surfaces of the duct shall be additionally secured by welded pins or adhered clips as specified for cut-to-size pieces. Other methods indicated in SMACNA HVAC Duct Const Stds to obtain proper installation of duct liners in sheet metal ducts, including adhesives and fasteners, will be acceptable.

3.1.18 Dust Control

To prevent the accumulation of dust, debris and foreign material during construction, temporary dust control protection shall be provided. The distribution system (supply and return) shall be protected with temporary seal-offs at all inlets and outlets at the end of each day's work. Temporary protection shall remain in place until system is ready for startup.

3.1.19 Insulation

Thickness and application of insulation materials for ductwork, piping, and equipment shall be according to Section 15080 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Outdoor air intake ducts and plenums shall be externally insulated up to the point where the outdoor air reaches the conditioning unit or up to the point where the outdoor air mixes with the outside air stream.

3.1.20 Duct Test Holes

Holes with closures or threaded holes with plugs shall be provided in ducts and plenums as indicated or where necessary for the use of pitot tube in balancing the air system. Extensions, complete with cap or plug, shall be provided where the ducts are insulated.

3.1.21 Power Roof Ventilator Mounting

Foamed 13 mm (1/2 inch) thick, closed-cell, flexible elastomer insulation shall cover width of roof curb mounting flange. Where wood nailers are used, holes shall be pre-drilled for fasteners.

3.1.22 Power Transmission Components Adjustment

V-belts and sheaves shall be tested for proper alignment and tension prior to operation and after 72 hours of operation at final speed. Belts on drive side shall be uniformly loaded, not bouncing. Alignment of direct driven couplings shall be to within 50 percent of manufacturer's maximum allowable range of misalignment.

3.2 FIELD PAINTING AND COLOR CODE MARKING

Finish painting of items only primed at the factory, surfaces not specifically noted otherwise, and color code marking for piping shall be as specified in Section 09900 PAINTING, GENERAL.

3.3 PIPING HYDROSTATIC TEST

After cleaning, water piping shall be hydrostatically tested at a pressure equal to 150 percent of the total system operating pressure for period of time sufficient to inspect every joint in the system and in no case less than 2 hours. Leaks shall be repaired and piping retested until test is successful. No loss of pressure will be allowed. Leaks shall be repaired by re-welding or replacing pipe or fittings. Caulking of joints will not be permitted. Concealed and insulated piping shall be tested in place before covering or concealing.

3.4 CLEANING AND ADJUSTING

Pipes shall be cleaned free of scale and thoroughly flushed of foreign matter. A temporary bypass shall be provided for water coils to prevent flushing water from passing through coils. Strainers and valves shall be thoroughly cleaned. Prior to testing and balancing, air shall be removed from water systems by operating the air vents. Temporary measures, such as piping the overflow from vents to a collecting vessel shall be taken to avoid water damage during the venting process. Air vents shall be plugged or capped after the system has been vented. Inside of room fan-coil units, air terminal units, unit ventilators, ducts, plenums, and casing shall be thoroughly cleaned of debris and blown free of small particles of rubbish and dust and then shall be vacuum cleaned before installing outlet faces. Equipment shall be wiped clean, with traces of oil, dust, dirt, or paint spots removed. Temporary filters shall be provided prior to startup of all fans that are operated during construction, and new filters shall be installed after all construction dirt has been removed from the building, and the ducts, plenums, casings, and other items specified have been vacuum cleaned. System shall be maintained in this clean condition until final acceptance. Bearings shall be properly lubricated with oil or grease as recommended by the manufacturer. Belts shall be tightened to proper tension. Control valves and other miscellaneous equipment requiring adjustment shall be adjusted to setting indicated or directed. Fans shall be adjusted to the speed indicated by the manufacturer to meet specified conditions.

3.5 TESTING, ADJUSTING, AND BALANCING

Testing, adjusting, and balancing shall be as specified in Section 15990 TESTING, ADJUSTING AND BALANCING OF HVAC SYSTEMS. Testing, adjusting, and balancing shall begin only when the air

supply and distribution, including controls, has been completed, with the exception of performance tests.

3.6 PERFORMANCE TESTS

After testing, adjusting, and balancing has been completed as specified, each system shall be tested as a whole to see that all items perform as integral parts of the system and temperatures and conditions are evenly controlled throughout the building. Corrections and adjustments shall be made as necessary to produce the conditions indicated or specified. Capacity tests and general operating tests shall be conducted by an experienced engineer. Tests shall cover a period of not less than 4 days for each system and shall demonstrate that the entire system is functioning according to the specifications.

3.7 FIELD TRAINING

The Contractor shall conduct a training course for operating and maintenance personnel as designated by the Contracting Officer. Training shall be provided for a period of 24 hours of normal working time and shall start after the system is functionally complete but prior to the performance tests. The field instruction shall cover all of the items contained in the approved Operating and Maintenance Instructions.

3.8 INDOOR AIR QUALITY ASSURANCE

Initial Building Flush Out: Prior to any furniture being placed in the building, but after completion of all scheduled interior construction finishes (trim, carpeting, painting, etc. but not including minor finish work associated with punchlist checks) operate the building's HVAC systems on 100% outdoor air for a period of 14 days to completely flush the building's air. Systems shall operate 18 hours/day on 100% outdoor air, with thermostats set to maintain space temperatures between 15.5°C (60°F) and 26.7°C(80°F). Promptly change out all system filters after this flush out period, and reset all adjusted items for normal operation.

Final Building Flush Out: After all furniture has been installed (unpacked and located) or at another similar time (as determined by the Owner), operate the building's HVAC systems on 100% outdoor air for an additional period of 14 days. Systems shall operate at least 18 hours/day on 100% outdoor air, with thermostats set to maintain space temperatures between 15.5°C (60°F) and 26.7°C(80°F). Promptly change out all system filters after this flush out period, and reset all adjusted items for normal operation.

END OF SECTION

SECTION 15910

DIRECT DIGITAL CONTROL SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AIR MOVEMENT AND CONTROL ASSOCIATION, INC. (AMCA)

AMCA 500 (1991) Louvers, Dampers and Shutters

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.10 (1997) Electromechanical Watt-hour Meters

ANSI C57.13 (1978; R 1987) Instrument Transformers

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING
ENGINEERS, INC. (ASHRAE)

ASHRAE 3 (1998) Reducing Emission of Fully Halogenated Refrigerants
in Refrigeration and Air-Conditioning Equipment and Systems

ASHRAE SSPC 135 (1995) The Building Automation and Control Network
(BACnet) Standard

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME/ANSI B16.5 (1996) Pipe Flanges and Flanged Fittings NPS 1/2 Through
NPS 24

ANSI B16.18 (1984; R 1994) Cast Copper Alloy Solder Joint Pressure
Fittings

ASME/ANSI B16.22 (1995) Wrought Copper and Copper Alloy Solder Joint
Pressure Fittings

ASME/ANSI B16.26 (1988) Cast Copper Alloy Fittings for Flared Copper Tubes

ASME/ANSI B16.34 (1996) Valves - Flanged, Threaded, and Welding End

ASME B31.1 (1995) Power Piping

ANSI/ASME B40.1 (1991; Special Notice 1992) Gauges - Pressure Indicating
Dial Type - Elastic Element

ASME BPVC SEC VIII	(1995; Addenda 1995) Boiler and Pressure Vessel Codes: Section VIII Pressure Vessels
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AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 126	(1995) Gray Iron Castings
ASTM B 32	91996) Solder Metal
ASTM B 75	(1995; Rev. A) Seamless Copper Tube
ASTM B 88M	(1996) Seamless Copper Water Tube (Metric)
ASTM B 88	(1996) Seamless Copper Water Tube
ASTM D 638	(1995) Tensile Properties of Plastics
ASTM D 792	(1991) Density and Specific Gravity (Relative Density) of Plastics by Displacement
ASTM D 1238	(1995) Flow Rates of Thermoplastics by Extrusion Plastometer
ASTM D 1693	(1995) Environmental Stress-Cracking of Ethylene Plastics

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(1996) National Electrical Code
NFPA 90A	(1993) Installation of Air Conditioning and Ventilating Systems

SHEET METAL & AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC.
(SMACNA)

SMACNA DCS	(1995; Addendum 1997) HVAC Duct Construction Standards - Metal and Flexible
SMACNA HVACTAB	(1993) HVAC Systems Testing, Adjusting and Balancing

UNDERWRITERS LABORATORIES INC. (UL)

UL 506	(1994; R 1994, Bul. 1994, 1995, and 1996) Specialty Transformers
UL 916	(1994; Bul. 1994 and 1996, R 1996) Energy Management Equipment
UL 1449	(1985; Errata 1986, Bul. 1993, 1994, and 1995) Transient Voltage Surge Suppressors

1.2 DEFINITIONS

1.2.1 Digital Controller

1.2.1.1 Interoperable Digital Controller (IDC)

A control module which is microprocessor based Interoperable LonMark™ or LonWorks. HVAC control is accomplished using LonMark™ based devices where the application has a LonMark™ profile defined. Where LonMark™ devices are not available, devices based on LonWorks are acceptable providing that an XIF file is provided for the device. An IDC is programmable by the user, has integral input/output within the module or on network connected modules, and performs stand-alone operations.

1.2.1.2 Interoperable BACnet Controller (IBC)

A control module which is microprocessor based Interoperable BACnet Controller in accordance with ANSI/ASHRAE Standard 135-1995. IBC's must be provided with product interoperability compliance statement documents that demonstrate the compliance level to the ANSI/ASHRAE Standard 135-1995.

1.2.2 Direct Digital Control (DDC)

Digital controls, as defined in this specification, performing control logic. The controller directly senses building environment and makes control decisions based on user defined, controller resident programs. The controller outputs control signals that directly operate valves, dampers, and motor controllers. No conventional control devices, pneumatic or electronic, such as receiver-controllers, thermostats, and logic units are present within or interface with a direct digital control loop. Actuators are electric or pneumatic, and the controller output is converted to the appropriate type of signal.

1.2.3 DDC System

A system made up of one or more interoperable digital controllers which communicate on a network.

1.2.4 Distributed Control

The intent of distributed control is to install the controllers near their respective controlled equipment. The control system consists of stand-alone controllers, with the total number of input and output points limited to 48 or less per controller. Failure of any single controller will not cause the loss of more than 48 control points.

1.2.5 Dynamic Control

A process that optimizes energy efficiency of HVAC systems (air handling units, converters, chillers, and boilers) by increasing and decreasing setpoints or starting and stopping equipment in response to heating and cooling needs of the facility. A requirement of dynamic control is knowing the heating/cooling demand status of the process. Therefore dynamic control requires controllers connected in a communications network.

1.2.6 Firmware

Firmware is software programmed into read only memory (ROM) and erasable programmable read only memory (EPROM) chips. Software may not be changed without physically altering the chip.

1.2.7 Graphic User Interface Software (GUI)

Graphic user interface software shall run on Microsoft Windows NT Workstation 4.0 service Pack 4, or later. The GUI employs browser like functionality that includes a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. Pull down menus and toolbars employ buttons, commands and navigation that permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object definition.

1.2.8 Hand-Held Terminal

A hand-held terminal is a manufacturer specific device connected directly to a communications port on a controller, through which the controller is accessed and, in some cases, programmed.

1.2.9 Input/Output (I/O) Points

I/O points refer to analog inputs (AI), digital inputs (DI), analog outputs (AO), and digital outputs (DO) in a digital controller. Another term for digital inputs and outputs is binary inputs and outputs. Inputs are from analog sensors (temperature, pressure, humidity, flow) and digital sensors (motor status, flow switches, switch position, and pulse output devices). Outputs operate modulating and on/off control devices.

1.2.10 I/O Expansion Unit

An I/O expansion unit provides additional point capacity to a digital controller and communicates with the stand-alone digital controller on a LAN. An I/O unit is not stand-alone because the control program does not reside in the I/O unit. An I/O expander which connects directly to a stand alone controller through a multi-line microprocessor bus is restricted to reside within 3 feet of the stand alone controller and is considered part of the stand alone controller.

1.2.11 Local Area Network (LAN)

a. A communications bus that interconnects digital controllers for peer-to-peer (see "peer-to-peer" below) communications. Different levels of LANs are possible within a single DDC system. In this case, a digital controller on a higher level LAN acts as a network controller to the controllers on the lower level LAN. The network controller, then, has at least two LAN communications ports. One port supports peer-to-peer communications with other digital controllers on the higher level LAN. The other port supports communications with the digital controllers on the lower level LAN.

b. LANs permit sharing global information. This allows building and site wide control strategies such as peak demand limiting, dynamic control strategies, coordinated response to alarm conditions, and remote monitoring and programming of digital controllers.

1.2.12 Microprocessor

A microprocessor refers to the central processing unit (CPU) that contains all registers and logic circuitry that allow digital controllers to function.

1.2.13 Network Area Controller (NAC), Tridium JACE (Java application control engine)

The network area controller (NAC) provides the interface between a higher level LAN or WAN and the interoperable digital controllers, providing global supervisory control functions. NAC's provide multiple user access at varying levels through password protection. The NAC shall be Tridium JACE. No other systems or gateway-based technologies shall be acceptable.

1.2.14 Output Signal Conversion

Output signal conversion refers to changing one kind of control output into a proportionally related signal appropriate for direct actuation of the controlled device. An example is converting a 4 to 20 mA or 0 to 10 VDC signal to a proportional 20 to 103 kPa (3 to 15 psig) signal to operate a pneumatic actuator.

1.2.15 Optimum Start

Optimum start is a method of starting HVAC equipment prior to scheduled occupancy in order to have the building at setpoint when occupied. Optimum start is based on the zone temperatures, zone setpoints, and outdoor temperature.

1.2.16 Peer-to-Peer

Peer-to-peer refers to controllers connected on a communications LAN that act independently, as equals, and communicate with each other to pass information.

1.2.17 Performance Verification Test

The performance verification test (PVT) is the formal commissioning of the DDC system performed after successful contractor field testing and prior to the second phase of DDC training. It is used as a means for final acceptance of the control system.

1.2.18 PID

PID refers to proportional, integral, and derivative control; the three types of action that are used in controlling modulating equipment.

1.2.19 Resolution

Refers to the number of possible states an input value or output value can take and is a function of the digital controller I/O circuitry; the A/D converter for input and the D/A converter for output. Ten bit resolution has 1024 possible states.

1.2.20 Stand-Alone Control

Refers to the digital controller performing required climate control, and energy management functions without connection to another digital controller or computer. Requirements for stand-alone control are a time clock, a microprocessor, resident control programs, PID control, and I/O. All stand-alone controllers have a communication port and firmware for direct connection and interrogation with a laptop computer or similar hand-held device. This interrogation includes parameter changes and program downloads.

1.2.21 Terminal Control Unit (TCU)

An off-the-shelf, stand-alone digital controller equipped for communication on a lower level LAN. TCUs may deviate from stand-alone only in receiving energy management and time information from a stand

alone digital controller. A TCU is commonly application specific and is used for distributed control of specific HVAC subsystems. A TCU communicates with other digital controllers. Typically, a TCU communicates on a lower level LAN. Examples where TCUs are used include small air handling units (AHUs), variable air volume (VAV) boxes, fan coil units, heat pumps, and hydronic zones..

1.3 TEMPERATURE CONTROL AND FACILITY MANAGEMENT AND CONTROL SYSTEM

The entire Temperature Control System (TCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating via LonMark/LonTalk and/or BACnet communication protocols to a Tridium JACE Network Area Controller (NAC).

The Tridium JACE NAC shall connect to the Fort Lewis Public Works intranet, local or wide area network, as specified or indicated. Access to the system, either locally in each building, or remotely from a central site or sites, shall be accomplished through standard Web browsers, via the Internet and/or local area network.

The Facility Management and Control System (FMCS) shall be comprised of a network of interoperable, stand-alone digital controllers communicating on an open protocol communication network to a host computer within the facility (when specified) using graphical user interface software and communicating via the Fort Lewis Public Works intranet to the Fort Lewis host computer in a remote location. The FMCS shall communicate to third party systems such as chillers, boilers, air handling systems, energy metering systems, other energy management systems, access control systems, fire-life safety systems and other building management related devices with open, interoperable communication capabilities.

Provide a new TC and FMCS including associated equipment and accessories. Manufacturer's products, including design, materials, fabrication, assembly, erection, examination, inspection, and testing shall be in accordance with ASME B31.1 and NFPA 70, except as modified herein or indicated otherwise.

The TC systems shall maintain stable temperature control and all other conditions as indicated. The end-to-end accuracy of the system, including temperature sensor error, wiring error, A/D conversion, and display, shall be .5 degree C (1 degree F) or less.

1.4 DDC SYSTEM DESCRIPTION

1.4.1 Design Requirements

1.4.1.1 Control System Schematic

Provide control system schematic that includes the following:

- a. Location of each input and output device
- b. Flow diagram of each HVAC component, for instance flow through coils, fans, dampers
- c. Name or symbol for each component such as V-1, DM-2, and T-1 for a valve, damper motor, and temperature sensor, respectively
- d. Setpoints
- e. Sensor range
- f. Actuator range

- g. Valve and damper schedules and normal position
- h. Switch points on input switches
- i. Written sequence of operation for each schematic
- j. Schedule identifying each sensor and controlled device with the following information:
 - (1) LAN and Software point name with send and receive address if applicable
 - (2) Point type (AO, AI, DO, DI)
 - (3) Point range
 - (4) Digital controller number for each point

1.4.1.2 Electrical Equipment Ladder Diagrams

Submit diagrams showing electrical equipment interlocks, including voltages and currents.

1.4.1.3 Component Wiring Diagrams

Submit a wiring diagram for each type of input device and each type of output device. Diagram shall show how the device is wired and powered; showing typical connections at the digital controller and each power supply, as well as at the device itself. Show for all field connected devices, including, but not limited to, control relays, motor starters, electric or electronic actuators, and temperature, pressure, flow, proof, and humidity sensors and transmitters.

1.4.1.4 Terminal Strip Diagrams

Submit a diagram of each terminal strip, including digital controller base terminal strips (digital controllers shall not be directly wired for ease of removal and replacement), terminal strip location, termination numbers and the associated point names.

1.4.1.5 Communication Architecture Schematic

Submit a schematic showing communication networks used for all DDC system controllers, workstations, and field interface devices. Schematic shall show hierarchical topology. The supplied system must incorporate the ability to access all data using Tridium JACE Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a contractor supplied and installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable.

1.5 SUBMITTALS

Submit manufacturers' specification sheets for each type of equipment to show compliance with the project specification. For each type of equipment highlight each compliance item and reference each item to the relevant specification paragraph number. Submit sufficient manufacturers' information to

allow verification of compliance by the reviewing authority. Equipment and software for which specification compliance data shall be submitted includes but is not limited to the following:

SD-01 Preconstruction Submittals

List of Drawings

List of Symbols and Abbreviations Used on Drawings

List of I/O Points

Equipment Components List

AC Power Table

SD-02 Shop Drawings

Drawings shall be on A1 (841 by 594 mm) 34 by 22 inch sheets in the form and arrangement shown. Drawings on 11 x 17 sheets shall be acceptable, subject to approval, if printed on high quality laser printer. The drawings shall use the same abbreviations, symbols, nomenclature and identifiers shown. Each control system element on a drawing shall have a unique identifier as shown. The HVAC Control System Drawings shall be delivered together as a complete submittal. Deviations must be approved by the Contracting Officer. Drawings shall be submitted along with Submittal SD-01, Data.

a. HVAC Control System Drawings shall include the following:

Sheet One: Drawing Index, HVAC Control System Legend.

Sheet Two: Valve Schedule, Damper Schedule.

Sheet Three: Compressed Air Station Schematic (if applicable).

Sheet Four: Control System Schematic and Equipment Schedule.

Sheet Five: Sequence of Operation and Data Terminal Strip Layout.

Sheet Six: Control Loop Wiring Diagrams and Ladder Diagrams

Sheet Seven: Motor Starter and Relay Wiring Diagram.

Sheet Eight: Communication Network Architecture and Block Diagram.

Sheet Nine: DDC Panel Installation and Block Diagram.

(Repeat Sheets Four through Seven for each AHU System.)

b. The HVAC Control System Drawing Index shall show the name and number of the building and military site. The Drawing Index shall list HVAC Control System Drawings, including the drawing number, sheet number, drawing title, and computer filename when used. The HVAC Control System Legend shall show generic symbols and the name of devices shown on the HVAC Control System Drawings.

c. The valve schedule shall include each valve's unique identifier, size, flow coefficient Kv (Cv), pressure drop at specified flow rate, spring range, positive positioner range, actuator size, close-off pressure data, dimensions, and access and clearance requirements data. Valve schedules may be submitted in advance but shall be included in the complete submittal.

d. The damper schedule shall contain each damper's and each actuator's identifier, nominal and actual sizes, orientation of axis and frame, direction of blade rotation, spring ranges, operation rate, positive positioner ranges, locations of actuators and damper end switches, arrangement of sections in multi-section dampers, and methods of connecting dampers, actuators, and linkages. The Damper Schedule shall include the maximum leakage rate at the operating static-pressure differential. The Damper Schedule shall contain actuator selection data supported by calculations of the torque required to move and seal the dampers, access and clearance requirements. Damper schedules may be submitted in advance but shall be included in the complete submittal.

e. The compressed air station schematic diagram shall show all equipment, including: compressor with motor horsepower and voltage; starter; isolators; manual bypasses; tubing sizes; drain piping and drain traps; reducing valves; dryer; and data on manufacturer's names and model numbers, mounting, access, and clearance requirements. Air Compressor and air dryer data shall include calculations of the air consumption of all current-to-pneumatic transducers and of any other control system devices to be connected to the compressed air station, and the compressed air supply dewpoint temperature at 140 kPa (20 psig). Compressed air station schematic drawings shall be submitted for each compressed air station.

f. The HVAC control system schematics shall show all control and mechanical devices associated with the HVAC system. A system schematic drawing shall be submitted for each HVAC system.

g. The HVAC control system equipment Schedule shall be developed. All devices shall have unique identifiers and shall be referenced in the equipment schedule. Information to be included in the equipment schedule shall be the control loop, device unique identifier, device function, setpoint, input range, and additional important parameters (i.e., output range). An equipment schedule shall be submitted for each HVAC system.

h. The HVAC control system sequence of operation shall reflect the language and format of this specification, and shall refer to the devices by their unique identifiers as shown. No operational deviations from specified sequences will be permitted without prior written approval of the Contracting Officer. Sequences of operation shall be submitted for each HVAC control system including each type of terminal unit control system.

i. The HVAC control system wiring diagrams shall be functional wiring diagrams which show the interconnection of conductors and cables to HVAC control panel terminal blocks and to the identified terminals of devices, starters and package equipment. The wiring diagrams shall show necessary jumpers and ground connections. The wiring diagrams shall show the labels of all conductors. Sources of power required for HVAC control systems and for packaged equipment control systems shall be identified back to the panel board circuit breaker number, HVAC system control panel, magnetic starter, or packaged equipment control circuit. Each power supply and transformer not integral to a controller, starter, or packaged equipment shall be shown. The connected volt-ampere load and the power supply volt-ampere rating shall be shown. Wiring diagrams shall be submitted for each HVAC control system.

SD-03 Product Data

DDC hardware

DDC capabilities

Variable frequency drive hardware

Workstation software

Input devices

Output devices

Surge and transient protection

Notebook computer

Hand-held terminal

Smoke detectors

Pneumatic tubing

SD-06 Test Reports

Field tests

Commissioning Report

Three copies of the HVAC control system commissioning procedures, in booklet form and indexed, 60 days prior to the scheduled start of commissioning. Commissioning procedures shall be provided for each HVAC control system, and for each type of terminal unit control system. The Commissioning procedures shall reflect the format and language of this specification, and refer to devices by their unique identifiers as provided by the contractor, or if applicable, as shown. The Commissioning procedures shall be specific for each HVAC system, and shall give detailed step-by-step procedures for commissioning of the system.

a. The Commissioning procedures shall include detailed, product specific set-up procedures, configuration procedures, adjustment procedures, and calibration procedures for each device. Where the detailed product specific commissioning procedures are included in manufacturer supplied manuals, reference may be made in the HVAC control system commissioning procedures to the manuals.

b. An HVAC control system commissioning procedures equipment list shall be included that lists the equipment to be used to accomplish commissioning. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Performance verification tests

Three copies of the HVAC Control System Performance Verification Test Procedures, in booklet form and indexed, 60 days before the Contractor's scheduled test dates. The performance verification test procedures shall refer to the devices by their unique identifiers as shown, shall explain, step-by-step, the actions and expected results that will demonstrate that the HVAC control system performs in accordance with the sequences of operation, and other contract documents. An HVAC control system performance verification test equipment list shall be included that lists the equipment to be used during performance verification testing. The list shall include manufacturer name, model number, equipment function, the date of the latest calibration, and the results of the latest calibration.

Training

Three copies of an outline for the HVAC control system training course with a proposed time schedule. Approval of the planned training schedule shall be obtained from the Government at least 60 days prior to the start of the training. Six copies of HVAC control system training course material 30 days prior to the scheduled start of the training course. The training course material shall include the operation manual, maintenance and repair manual, and paper copies of overheads used in the course.

SD-07 Certificates

Contractors' Qualifications

Training

Pressure Tank Certification

SD-10 Operation and Maintenance Data

Controls and HVAC System Operators Manual

Provide three copies of a Control and HVAC Systems Operators Manual. Provide in a 3 ring binder with a minimum of the following 7 sections. Use tabs to divide each section.

- a. Description of HVAC Systems: Provide a description of the HVAC system components and control system. Include sequence of operation and a complete points list.
- b. Controls Drawings: Provide drawings as specified in submittal paragraph.
- c. Control Program Listings: Provide listing of all control programs, including terminal equipment controller setup pages if used.
- d. Current Operating Parameters: Provide printouts of input and output setup information, (database setups). This section provides information such as point addresses, slopes and offsets for all points, database of points, etc.
- e. Design Information: Provide tab, but leave this section blank.
- f. Control Equipment Technical Data Sheets and Adobe Acrobat .pdf files: Provide technical data sheets, installation and maintenance instructions for all controller hardware and accessories, as well as Adobe Acrobat .pdf files.

g. Backup of Control Program: Provide backup copies of the control program and ACAD or Viso control drawings on 3.5 inch disks, CD-ROM, and 100MB Zip Disks. Provide control drawings in Adobe Acrobat .pdf files for use with Acrobat Reader.

DDC Manufacturer's Hardware and Software Manuals

Provide three copies of the following manuals.

- a. Installation and Technical Manuals for all digital controller hardware.
- b. Installation and Technical Manuals for workstation.
- c. Operator Manuals for all digital controllers.
- d. Operator Manuals for all workstation software.
- e. Programming Manuals for all digital controllers.
- f. Programming Manuals for workstation software.
- g. In addition to manuals, provide copy of manuals on removable media disk or on workstation in Adobe Acrobat .pdf format.

SD-11 Closeout Submittals

Posted operating instructions:

Air compressors

Refrigerated air dryer

Provide administrative and closeout submittals:

Training course documentation

Service organizations

Contractor certification

1.6 OPERATING ENVIRONMENT

Protect components from humidity and temperature variations, dust, and other contaminants, within limits published by the manufacturer.

1.7 QUALITY ASSURANCE

1.7.1 Standard Products

- a. Material and equipment shall be standard products of manufacturer regularly engaged in the manufacturing of such product, using similar materials, design and workmanship. The

standard products shall have been in commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include applications of similarly sized equipment and materials used under similar circumstances and sold on the commercial market through advertisements, manufacturers' catalogs, or brochures.

b. Products are supported by a local service organization.

1.7.2 Nameplates and Tags

a. Nameplates and tags bearing device unique identifiers shall be engraved or stamped. Permanently attach nameplates to HVAC control panel doors and back plates.

b. For each field mounted piece of equipment attach a plastic or metal tag with equipment name and point identifier.

1.7.3 Verification of Dimensions

The contractor shall verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing work.

1.7.4 Drawings

Because of the small scale of the drawings, it is not possible to indicate all offsets, fittings, and accessories that may be required. The Contractor shall carefully investigate the mechanical, electrical, and finish conditions that could affect the work, and shall furnish all work necessary to meet such conditions.

1.7.5 Contractors Qualifications

The Contractor or subcontractor performing the work shall have completed a minimum of five DDC systems installations of similar design and complexity and have successfully integrated Tridium JACE NAC's in at least three separate installations.

1.7.6 Pressure Tank Certification

Provide certification stating pressure tanks are constructed and labeled in accordance with ASME BPVC SEC VIII for a minimum of 125 psig working pressure.

1.7.7 Training Course Documentation

Training course documentation shall include a manual for each trainee plus two additional copies and two copies of audiovisual training aids, if used. Documentation shall include an agenda, defined objectives for each lesson and detailed description of the subject matter of each lesson.

1.7.8 Service Organizations

Qualified service organization list that shall include the names and telephone numbers of organizations qualified to service the HVAC control systems.

1.7.9 Contractor Certification

Provide certification that the installation of the control system is complete and meets the technical requirements of this section.

1.7.10 Modification of References

The advisory provision in ASME B31.1 and NFPA 70 are mandatory. Substitute the word "shall" for "should" wherever it appears and interpret all references to the "authority having jurisdiction" and "owner" to mean the Contracting Officer.

1.8 WARRANTY

1.8.1 Year 2000 (Y2K) Compliance Warranty

For each product, component and system specified in this section as a "computer controlled facility component" provide a statement of Y2K compliance warranty. The contractor warrants that each hardware, software, and firmware product delivered under this contract is able to accurately process date and time data (including, but not limited to, calculating, comparing, and sequencing) from, into, and between the twentieth and twenty-first centuries, including years 1999 and 2000 and leap year calculations. The duration of this warranty and the remedies available to the Government for breach of this warranty shall be defined in, and subject to, the terms and limitations of the contractor's standard commercial warranty or warranties contained in this contract. Nothing in this warranty shall be construed to limit any rights or remedies the Government may otherwise have under this contract, with respect to defects other than Year 2000 performance.

PART 2 PRODUCTS

2.1 DDC SYSTEM

- a. Provide a DDC system as a distributed control system. The system shall have stand-alone Interoperable LonMark™ or LonWorks, or BACnet digital controllers, a communications Network with Network Access Controllers (NAC's) in each facility, capable of serving as a WEB browser server if specified, and a separate workstation computer with workstation software.
- b. Provide an operator programmable system to perform closed-loop, modulating control of building equipment. Connect all digital controllers through the communication network to share common data and report to workstation computers. Provide workstation DDC software capable of programming and monitoring the digital controllers. The control system shall be capable of downloading programs between the workstation and digital controllers.
- c. Provide the quantity of digital controllers as required to perform the sequences of operation, or where shown, as indicated on the drawings to perform required climate control, energy management, and alarm functions. The quantity of controllers shall be no less than that required to perform the sequences of operation within the parameters indicated in these specifications. All material used shall be currently in production.
- d. The LonMark/LonWorks or BACnet controllers shall be connected through Tridium JACE network area controllers to the Fort Lewis Public Works intranet, local, or wide area network.

2.1.1 Interoperable Direct Digital Controllers

DDC hardware shall be UL 916 rated. Interoperable controllers (IDC's) shall be LonMark™ or LonWorks bearing the applicable LonMark™ interoperability logo. Where LonMark™ devices are not available, devices based on LonWorks are acceptable providing that an XIF file is provided for the device. Controllers shall be programmable by the user, have integral input/output within the module or on network connected modules, and perform stand-alone operations. Interoperable BACnet Controllers (IBC's) shall be in accordance with ANSI/ASHRAE Standard 135-1995. IBC's must be provided with product interoperability compliance statement documents that demonstrate the compliance level to the ANSI/ASHRAE Standard 135-1995.

2.1.1.1 Distributed Control

Apply digital controllers in a distributed control manner.

2.1.1.2 I/O Point Limitation

Total number of I/O hardware points, including those communicated over a LAN, used by a single stand-alone digital controller, including I/O expansion units shall not exceed 48.

2.1.1.3 Environmental Operating Limits

Provide digital controllers that operate in environmental conditions between 32 and 120 degrees F.

2.1.1.4 Stand-Alone Control

Provide stand-alone digital controllers.

2.1.1.5 Internal Clock

Provide a clock with each stand-alone controller. The facility NAC shall also provide time keeping functions to stand alone controllers and TCU's. Each controller shall have its clock backed up by a battery or capacitor with sufficient capacity to maintain clock operation for a minimum of 72 hours during power outage.

2.1.1.6 Memory

a. Provide sufficient memory for each controller to support required control, communication, trends, alarms, and messages

b. Memory Protection: Programs residing in memory shall be protected either by using EEPROM, flash memory, or by an uninterruptible power source (battery or uninterruptible power supply (UPS)). The backup power source shall have sufficient capacity to maintain volatile memory during an AC power failure. Where the uninterruptible power source is rechargeable (a rechargeable battery), provide sufficient back-up capacity for a minimum of seventy-two hours. The rechargeable power source shall be constantly charged while the controller is operating under normal line power. Where a non-rechargeable power source is used, provide sufficient capacity for a minimum of two years accumulated power failure. Batteries shall be replaceable without soldering.

2.1.1.7 Inputs

Provide input function integral to the direct digital controller. Provide input type(s) as required by the DDC design. For each type of input used on high-level controllers, provide at least one similar spare input point per controller.

- a. Analog Inputs: Allowable input types are 100 ohm (or higher) platinum RTDs, thermistors, 4 to 20 mA, and 0-10 VDC. Thermistor and direct RTD inputs must have appropriate conversion curves stored in controller software or firmware. Analog to digital (A/D) conversion shall have 10-bit minimum resolution.
- b. Digital Inputs: Digital inputs shall sense open/close, on/off, or other two state indications.

2.1.1.8 Outputs

Provide output function integral to the direct digital controller. Provide output type(s) as required by the DDC design. For each type of output used on high-level controllers, provide at least one similar spare output point per controller.

- a. Analog Outputs: Provide controllers with a minimum output resolution of 10 bits. Output shall be 4 to 20 mA, 0 to 10 VDC, or 0 to 20 psig. Each pneumatic output shall have feedback for monitoring of the actual pneumatic signal.
- b. Digital Outputs: Provide contact closure with contacts rated at a minimum of 1 ampere at 24 volts.

2.1.1.9 PID Control

Provide controllers with proportional integral, and derivative control capability. Terminal controllers are not required to have the derivative component.

2.1.1.10 Digital Controller Networking Capabilities

The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system with the capability to integrate both the ANSI/ASHRAE Standard 135-1995 BACnet and LonWorks technology communication protocols in one open, interoperable system. The upper level digital controllers shall be capable of networking with other similar upper level controllers. Upper level controllers shall also be capable of communicating over a network between buildings.

2.1.1.10.1 LonMark™ IDC Networking Capabilities

The contractor shall run the LonWorks network trunk to a Tridium JACE Network Area Controller (NAC). Coordinate locations of the NAC to ensure that maximum network wiring distances, as specified by the LonWorks wiring guidelines, are not exceeded. A maximum of 126 devices may occupy any one LonWorks trunk and must be installed using the appropriate trunk termination device. All LonWorks and LonMark devices must be supplied using FTT-10A LonWorks communications transceivers. The IDCs shall communicate with the NAC at a baud rate of not less than 78.8K baud. The IDC shall provide LED indication of communication and controller performance to the technician, without cover removal.

2.1.1.10.2 IBC Networking Capabilities

The system supplier must provide a PICS document showing the installed systems compliance level to the ANSI/ASHRAE Standard 135-1995. Minimum compliance is Level 6.

Physical connection of BACnet devices shall be via Ethernet.

The IBC Sensor shall connect directly to the IBC and shall not utilize any of the I/O points of the controller. The IBC Sensor shall provide a two-wire connection to the controller that is polarity and wire type insensitive. The IBC Sensor shall provide a communications jack for connection to the BACnet communication trunk to which the IBC controller is connected. The IBC Sensor, the connected controller, and all other devices on the BACnet bus shall be accessible by the portable operators terminal (POT).

2.1.1.11 Communications Ports

a. Controller-to-Controller LAN Communications Ports: Controllers in the building DDC system shall be connected in a communications network. Controllers shall have controller to controller communication ports to both peer controller (upper level controllers) and terminal controllers (lower level controllers). Network may consist of more than one level of local area network and one level may have multiple drops. Communications network shall permit sharing information between controllers, allowing execution of dynamic control strategies, and coordinated response to alarm conditions. Minimum baud rate for the lowest level LAN shall be 9600 Baud. Minimum baud rate for the highest level LAN shall be 9600 Baud. Minimum baud rate for a DDC system consisting of a single LAN shall be 9600 Baud.

b. On-Site Interface Ports: Provide a RS-232, RS-485, or RJ-11 communications port for each digital controller that allows direct connection of a computer or hand held terminal and through which the controller may be fully accessed. Controller access shall not be limited to access through another controller. On-site interface communication ports shall be in addition to the communications port(s) supporting controller to controller communications. Communication rate shall be 9600-Baud minimum. Every controller on the highest level LAN shall have a communications port supporting direct connection of a computer; a hand held terminal port is not sufficient. By connecting a computer to this port, every controller in the direct digital control system shall be able to be fully accessed and programmed. The following operations shall be available: downloading and uploading control programs, modifying programs and program data base, and retrieving or accepting trend reports, status reports, messages, and alarms.

c. Remote Work Station Interface Port: Provide one additional direct connect computer port in each DDC system for permanent connection of a remote operator's work station, unless the workstation is a node on the LAN. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through this port.

d. Telecommunications Interface Port: Provide one additional telecommunications port in each DDC system permitting remote communications via telephone. All operations possible by directly connecting a computer to a controller at the highest level LAN shall be available through the telecommunications port. A telecommunications port provided on a digital controller shall be in addition to the port required for directly connecting a computer to the controller. Telecommunication baud rate shall be 28000 minimum.

2.1.1.12 Y2K Compliant

Provide computer controlled facility components, specified in this section, that are Year 2000 compliant (Y2K). Computer controlled facility components refers to software driven technology and embedded microchip technology. This includes, but is not limited to, computers, telecommunications switches, meters, HVAC controllers, utility monitoring and control systems, fire detection instruments, alarms, security systems, and other facilities control systems utilizing microcomputer, minicomputer, or programmable logic controllers

2.1.1.13 Modem

Provide two modems per DDC system to communicate between the digital control system and the computer workstation. Minimum modem baud rate is 56 Kbaud with v.90 communication standard.

2.1.1.14 Digital Controller Cabinet

Each indoor digital controller cabinet shall protect the controller from dust and shall be rated NEMA 1, unless specified otherwise. Each outdoor digital controller cabinet shall protect the controller from all outside conditions and shall be rated NEMA 4. Cabinets for high level controllers shall be hinged door, lockable, and have offset removable metal back plate.

2.1.1.15 Main Power Switch

Each controller on the highest level LAN or each control cabinet shall have a main external power switch for isolation of the controller from AC power. The switch shall be located in the DDC cabinet.

2.1.2 Terminal Control Units

- a. The same company as the digital controllers shall manufacture TCUs.
- b. TCUs shall automatically start-up on return of power after a failure, and previous operating parameters shall exist or shall be automatically downloaded from a digital controller on a higher level LAN.
- c. TCUs do not require an internal clock, if they get time information from a higher level digital controller.

2.1.3 DDC Software

The Contracting Officers representative shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Ft. Lewis as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. In addition, adherence to industry standards including ANSI / ASHRAE™ Standard 135-1995, BACnet and LonMark to assure interoperability between all system components is required. For each LonWorks device that does not have LonMark certification, the device supplier must provide an XIF file for the device. For each BACnet device, the device supplier must provide a PICS document showing the installed device's compliance level. Minimum compliance is Level 6; with the ability to support data read and write functionality.

2.1.3.1 Sequence of Control

Provide, in the digital controllers, software to execute the sequence of control. Provide one registered copy of all software used to program control sequences in direct digital controllers, LAN controllers and field configurable smart controllers on the stationary (notebook) workstation. Provide any access keys which restrict programming language software functions or the ability to compile or prepare programming for download to controllers. Provide final copy of each program used in the system in both compiled and editable formats. Where specially programmed factory configured smart controllers are used in the system, provide the minimum factory programming tools and specialized controller programs ready for download to replacement controllers. At minimum, controllers must be capable of performing programming functions outlined in the following "Parameter Modification" section.

2.1.3.2 Parameter Modification

Provide software to modify control parameters. Parameter modification shall be accomplished for all controllers (high level and low level application specific) through the main workstation computer and with laptop computer or keypad terminal directly at each controller. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Modifications shall be accomplished without having to make changes directly in line-by-line programming. When the control program is of the line-by-line type, database parameters in the following list that take real number values shall require assignment of variable names so parameters can be changed without modifying programming. Alternatively, block programming languages shall provide for modification of these database parameters in fill-in-the-blank screens. Parameters of like type, including those in different high level and low level controllers, may be grouped together for a single, global change. For example, an operator may group all second floor space temperature setpoints into a group and raise the setpoint by two degrees with a single command. The following parameters shall be modifiable in this way:

- a. Setpoints
- b. Dead band limits and spans
- c. Reset schedules
- d. Switchover points
- e. PID gains and time between control output changes
- f. Time
- g. Timed local override time
- h. Occupancy schedules
- i. Holidays
- j. Alarm points, alarm limits, and alarm messages
- k. Point definition database
- l. Point enable, disable, and override
- m. Trend points, trend intervals, trend reports

- n. Analog input default values
- o. Passwords
- p. Communications parameters including network and telephone communications setups

2.1.3.3 Differential

Where setpoint is in response to some analog input such as temperature, pressure, or humidity, include a setpoint differential for the control loop to prevent short cycling of control devices.

2.1.3.4 Motor and Flow Status Delay

Provide an adjustable delay between when a motor is commanded on or off and when the control program looks to the motor or flow status input for confirmation of successful command execution.

2.1.3.5 Runtime Accumulation

Provide resettable run time accumulation for each controlled digital output.

2.1.3.6 Timed Local Override

Provide user definable adjustable run time for each push of a momentary contact timed local override. Pushes shall be cumulative with each push designating the same length of time. Provide a user definable limit on the number of contact closures summed, such as 6, before the contact closures are ignored. Timed local overrides are disabled during occupancy periods.

2.1.3.7 Time Programs

Provide programs to automatically adjust for leap years, and make daylight savings time and standard time adjustments.

2.1.3.8 Scheduling

- a. Individual controlled equipment shall be schedulable with schedule based on time of day, day of week, and day of year. Equipment may be associated into groups. Each group may be associated with a different schedule. Changing the schedule of a group shall change the schedule of all equipment in the group. Groups may be modified, created and deleted by the operator.
- b. Provide capability that will allow current schedules to be viewed and modified in a seven-day week format. When control program does not automatically compute holidays, provide capability to enter holiday schedules one full year at a time.

2.1.3.9 Point Override

I/O and virtual points shall accept software overrides to any possible value.

2.1.3.10 Alarming

I/O points and software points shall be alarmable. Alarms may be enabled and disabled for every point. Alarm limits shall be adjustable on analog points. Controllers connected to an external communications device such as a printer, terminal, or computer, shall download alarm and alarm message when alarm occurs. When a computer workstation is connected to a DDC system with a modem, operator selected alarm conditions will initiate a call and report to the computer or an alphanumeric pager. Otherwise alarms will be stored and automatically downloaded when a communications link occurs. The following conditions shall generate alarms:

- a. Motor is commanded on or off but the motor status input indicates no change
- b. Temperature, humidity, or pressure strays outside selectable limits
- c. An analog input takes a value indicating sensor failure
- d. A module is not communicating on the LAN
- e. A power outage occurs

2.1.3.11 Messages

Messages shall be operator defined and assigned to alarm or status conditions. Messages shall be displayed on the workstation or printer when these conditions occur.

2.1.3.12 Trending

DDC system shall have the capability to trend all I/O and virtual points. Points may be associated into groups. A trend report may be set up for each group. The period between logging consecutive trend values shall range from one minute to 60 minutes at a minimum. The minimum number of consecutive trend values stored at one time shall be 30 per variable. When trend memory is full, the most recent data shall overwrite the oldest data. Trend data shall be capable of being uploaded to computer. Trend data shall be available on a real time basis; trend data shall appear numerically and graphically on a connected computer's screen as the data is processed from the DDC system. Trend reports shall be capable of uploading to computer for storage.

2.1.3.13 Status Display

Current status of I/O and virtual points shall be displayed on command. Points shall be associated into functional groups, such as all the I/O and virtual points associated with control of a single air handling unit, and displayed as a group, so the status of a single mechanical system can be readily checked. A group shall be selectable from a menu of groups having meaningful names; such as AHU-4, Second Floor, Chiller System, and other such names.

2.1.3.14 Diagnostics

Each controller shall perform self-diagnostic routines and provide messages to an operator when errors are detected. The DDC system shall be capable of recognizing a non-responsive module on a LAN. The remaining, responsive modules on a LAN shall not operate in a degraded mode.

2.1.3.15 Power Loss

During a power outage, each controller shall assume a disabled status and outputs shall go to a user definable state. Upon restoration of power, DDC system shall perform an orderly restart, with sequencing of outputs.

2.1.3.16 Program Transfer

Provide software for download of control programs and database from a computer to controllers and upload of same to computer from controllers. Every digital controller in the DDC system shall be capable of being downloaded and uploaded to through a single controller on the highest level LAN.

2.1.3.17 Password Protection

Provide at least three levels of password protection to the DDC system permitting different levels of access to the system. The lowest level allows monitoring only. The highest level allows full control of all functions, including setting new passwords.

2.1.4 Workstation

- a. Provide a central workstation computer with installed software to provide an interface for monitoring, troubleshooting, and making adjustments to the program or operating parameters of all DDC controllers, including TCUs. The workstation shall also be capable of programming all controllers, including TCUs.
- b. DDC system shall routinely operate continuously without connection to the workstation. Information at the workstation is not required for day to day operations of the direct digital controllers.

2.1.4.1 Hardware

The DDC system manufacturer shall recommend all workstation computer equipment and peripherals. The workstation shall be configured to operate according to the DDC system manufacturer's specifications. Workstation hardware shall be configured to allow operation of software, uploading and downloading of programs, and creation of graphics. At a minimum the workstation hardware shall consist of:

- a. Computer; computer shall use Microsoft Windows 98, NT or higher and shall not have less than Intel Pentium III processor, running at 1 Gigahertz speed, 20 gigabyte hard disc, 128 megabyte RAM, 2 serial and 1 parallel port, 17 inch monitor with 1024 x 768 and 0.28 dpi minimum resolution, 101 character keyboard, a 1.4 megabyte 3 1/2 inch floppy drive, 48X internal CD ROM drive, internal 100MB Zip drive with 2 Zip disks.
- b. Mouse
- c. Printer; printer resolution shall be inkjet laser quality.
- d. 120-volt terminal strip UL 1449 6-outlet with surge protection.

2.1.4.2 Software

Workstation software shall be recommended and supported by the DDC system manufacturer and configured to operate according to the DDC system manufacturer's specifications. Software shall be resident in the workstation computer and permit monitoring and troubleshooting of the DDC system. Workstation software permits modification of controller parameters and control for all controllers, both high level and low level application specific. Operations shall be menu selected. Menu selections shall be made with a mouse.

- a. Menu System: Menu system shall allow an operator to select a particular function or access a particular screen through successive menu penetration.
- b. Controller Parameter Modification: The workstation software shall be an interface for performance specified in paragraph entitled "Parameter Modification" and available through direct connection of a computer to a digital controller. Parameter modification shall require only that an operator "fill in the blank" for a parameter on a screen requesting the information in plain language. Parameter modifications shall download to the appropriate controllers at operator request.
- c. Program modification: For systems using a line-by-line programming language, provide an off-line text editor, similar to a BASIC program editor, permitting modification of controller resident control programs. For systems using block programming languages provide a capability for linking blocks together to create new programs or modify existing programs. Program modifications shall download to appropriate controllers at operator request.

2.1.4.3 Graphic-Based Software

The workstation shall use graphic-based software to provide a user-friendly interface to the DDC system. Graphic-based software shall provide graphical representation of the building, the buildings mechanical systems, and the DDC system. The current value and point name of every I/O point shall be shown on at least one graphic and in its appropriate physical location relative to building and mechanical systems.

- a. Graphics shall closely follow the style of the control drawings in representing mechanical systems, sensors, controlled devices, and point names.
- b. Graphic Title: Graphics shall have an identifying title visible when the graphic is being viewed.
- c. Dynamic Update: When the workstation is on-line with the control system, point data shall update dynamically on the graphic images.
- d. Graphic Penetration: Provide graphic penetration when the capability exists. For systems without graphic penetration, provide menu penetration for selection of individual graphics to give the same hierarchical affect provided by graphic penetration.
- e. Graphic Types: Graphic-based software shall have graphics of the building exterior, building section, floor plans, and mechanical systems. Provide the following graphics:
 - (1) Building Exterior Graphic: Show exterior architecture, major landmarks, and building number.
 - (2) Building Section Graphic: Show floors in section graphic with appropriate floor name on each floor.
 - (3) Floor Plan Graphics: Provide a single graphic for each floor, unless the graphic will contain more information than can reasonably be shown on a single graphic. Each heating or cooling zone within a floor plan shall have a zone name and its current temperature displayed within the zone outline. Show each controlled variable in the zone. Provide visual warning for each point in alarm.

(4) Mechanical System Graphics: Provide two-dimensional drawings to symbolize mechanical equipment; do not use line drawings. Show controlled or sensed mechanical equipment. Each graphic shall consist of a single mechanical system; examples are a graphic for an air handling unit, a graphic for a VAV box, a graphic for a heating water system, and a graphic for a chiller system. Place sensors and controlled devices associated with mechanical equipment in their appropriate locations. Place point name and point value adjacent to sensor or controlled device. Provide visual warning of each point in alarm. Condition, such as zone temperature, associated with the mechanical system shall be shown on the graphic. Point values shall update dynamically on the graphic.

f. Graphic Editing: Full capacity as provided by a draw software package shall be included for operator editing of graphics. Graphics may be created, deleted, modified, and text added. Provide capability to store graphic symbols in a symbol directory and import these symbols into graphics. A minimum of 256 colors shall be available.

g. Dynamic Point Editing: Provide full editing capability for deleting, adding, and modifying dynamic points on graphics.

h. Trending: Trend data shall be displayed graphically, with control variable and process variable plotted as functions of time on the same chart. Graphic display of trend data shall be internal to the workstation software and not resulting from download of trend data into a third-party spreadsheet program such as Excel, unless such transfer is automatic and transparent to the operator, and the third-party software is included with the workstation software package. At the operator's discretion, trend data shall be plotted real time.

2.1.5 Maintenance Personnel Interface Tools

Provide a notebook computer for field communication with the digital controllers. In addition to changing setpoints, and making operational changes, field personnel shall be able to download programs with the notebook computer.

2.1.5.1 Notebook Computer

a. Provide notebook computer, necessary software, and direct connection cable to communicate with all digital controllers and smart thermostats when directly connected.

b. Provide notebook computer with the following features as a minimum:

(1) Pentium III 1 GHz with active matrix color screen

(2) Internal hard disk; minimum 20 Gigabytes

(3) Internal battery operation; for a minimum of 3 hours of operation.

(4) RAM; minimum 128 Megabytes

(5) 24X CD ROM and 3.5 inch 1.44 MB floppy drive

(6) Serial interface port or Ethernet port to communicate with the digital controller. Parallel port to communicate with a printer.

(7) Software: Digital control manufacturer's graphic DDC software, and all other required programs installed. Windows 98, NT or higher operating system installed. Include all documentation and original media.

2.2 SENSORS AND INPUT HARDWARE

2.2.1 Field Installed Temperature Sensors

2.2.1.1 Thermistors

Precision thermistors may be used in temperature sensing applications below 200 degrees F. Sensor accuracy over the application range shall be 0.36 degree F or less between the range of 0 to 66 degrees C (32 to 150 degrees F). Stability error of the thermistor over five years shall not exceed 0.14 degrees C (0.25 degree F) cumulative. Sensor element and leads shall be encapsulated. Bead thermistors are not allowed. A/D conversion resolution error shall be kept to 0.06 degree C (0.1 degree F). Total error for a thermistor circuit shall not exceed 0.28 degree C (0.5 degree F), which includes sensor error and digital controller A/D conversion resolution error. Provide 18 gage twisted and shielded cable for thermistors.

2.2.1.2 Resistance Temperature Detectors (RTDs)

Provide RTD sensors with 1000 ohm, or higher, platinum elements that are compatible with the digital controllers. Sensors shall be encapsulated in epoxy, series 300 stainless steel, anodized aluminum, or copper. Temperature sensor accuracy shall be 0.1 percent (1 ohm) of expected ohms (1000 ohms) at 0 degrees C (32 degrees F). Temperature sensor stability error over five years shall not exceed 0.14 degree C (0.25 degree F) cumulative. Direct connection of RTDs to digital controllers, without transmitters, is preferred provided controller supports direct connection of RTDs. When RTDs are connected directly to the controller, keep lead resistance error to 0.14 degree C (0.25 degree F) or less. Total error for a RTD circuit shall not exceed 0.28 degree C (0.5 degree F), which includes sensor error, lead resistance error or 4 to 20 mA or 0 to 10 VDC transmitter error, and A/D conversion resolution error.

2.2.1.3 Temperature Sensor Details

- a. Room Type: Conceal element behind protective cover matched to the room interior. Room temperature sensors connected directly to application specific controllers shall have integral pushbutton, system override digital input button, and a setpoint adjustment lever
- b. Duct Averaging Type: Continuous averaging RTDs for ductwork applications shall be 30 centimeters in length for each 0.37 square meters (one foot in length for each 4 square feet) of ductwork cross-sectional area with a minimum length of 1.8 meter (6 feet). Probe type duct sensors of 30 centimeter (one foot) length minimum are acceptable in ducts 1.1 square meter (12 feet square) and less.
- c. Immersion Type: 75 mm (3 inches) total immersion for use with sensor wells, unless otherwise indicated.
- d. Sensor Wells: Stainless steel material. Provide heat-sensitive transfer agent between exterior sensor surface and interior well surface.
- e. Outside Air Type: Provide element on the buildings north side with sunshade to minimize solar effects. Mount element at least 75 mm (3 inches) from building outside wall.

Sunshade shall not inhibit the flow of ambient air across the sensing element. Shade shall protect sensing element from snow, ice, and rain.

2.2.2 Transmitters

Transmitters shall have 4 to 20 mA or 0 to 10 VDC output linearly scaled to the temperature, pressure, humidity, or flow range sensed. Transmitter shall be matched to the sensor, factory calibrated, and sealed. Total error shall not exceed 0.1 percent at any point across the measured span. Supply voltage shall be 24 volts ac or dc. Transmitters shall have non-interactive offset and span adjustments. For temperature sensing, transmitter stability shall not exceed 0.05 degrees C (0.09 degrees F) a year.

2.2.2.1 Spans and Ranges

Transmitter spans or ranges shall meet the following:

a. Temperature:

(1) 28 degrees C (50 degrees F) span: Room, chilled water, cooling coil discharge air, return air sensors

(2) 56 degrees C (100 degrees F) span: Outside air, hot water, heating coil discharge air, mixed air sensors

(3) 111 degrees C (200 degrees F) span: High temperature hot water, heating hot water, chilled/hot water system sensors.

b. Pressure:

(1) -125 to 125 pascals (-0.5 to 0.5) inches water differential range: static pressure control of rooms

(2) 0 to 1250 pascals (0 to 5 inches) water differential range: Duct static pressure

(3) 0 to 689 kPa (0 to 100 psig) differential: Water differential pressure

c. Relative Humidity:

(1) 10 to 90 percent minimum relative humidity range

2.2.3 Relative Humidity Transmitters

Provide integral humidity transducer and transmitter. Output of relative humidity instrument shall be a 4 to 20 mA or 0 to 10 VDC signal proportional to full range of relative humidity input. Accuracy shall be 2 percent of full scale, long-term stability shall be less than one percent drift per year. Sensing element shall be polymer or thin film polymer type.

2.2.4 Pressure Transmitters

Provide integral pressure transducer and transmitter. Output of pressure instrument shall be a 4 to 20 mA or 0 to 10 VDC signal proportional to the pressure span. Span shall be as specified. Accuracy shall be 1.0 percent. Linearity shall be 0.1 percent.

2.2.5 Current Transducers

Provide current transducers to monitor amperage of motors. Select current transducer for normal measured amperage to be near 50 percent of full-scale range. Current transducers shall have an accuracy of one percent and 4 to 20 mA or 0 to 10 VDC output signal.

2.2.6 Air Quality Sensors

2.2.6.1 CO2 Sensor

Provide CO2 sensors with integral transducers where shown. Output signal shall be 4 to 20 mA or 0 to 10 VDC. Accuracy shall be ± 5 percent of full scale.

2.2.7 Input Switches

2.2.7.1 Timed Local Override

Provide momentary contact push button override with override time set in controller software. Provide to override DDC time of day program and activate occupancy program for assigned units. Upon expiration of override time, the control system shall return to time-of-day program. Time interval for the length of operation shall be software adjustable and shall expire unless reset.

2.2.7.2 Insertion Freeze Protection Switch

Electric switch shall be capillary type. Provide special purpose insertion thermostats with flexible elements a minimum of 6 meters (20 feet) in length for coil face areas up to 3.7 square meters (40 square feet). Switch contacts shall be rated for motor starter circuit voltage being interrupted. Switch shall be equipped with auxiliary set of contacts for input of switch status to digital controller. Provide additional elements or longer elements for larger coils at the rate of 30 centimeters (1-foot) of element per .37 square meters (4 square feet) of coil. Serpentine capillaries perpendicular to the air flow to uniformly sense the entire airflow. A freezing condition at 18-inch increments along the sensing element shall activate the thermostatic switch. Switch shall require manual reset after activation.

2.2.7.3 Electronic Airflow Measurement Stations and Transmitters

a. Station - Each station shall contain an array of velocity sensing elements and straightening vanes inside a flanged sheet metal casing. The velocity sensing elements shall be of the RTD or thermistor type. The sensing elements shall be distributed across the duct cross section in the quantity and pattern set forth for measurements and instruments of ASHRAE 3 and SMACNA HVACTAB for the traversing of ducted air flows. The resistance to airflow through the airflow measurement station shall not exceed 20 pascals (0.08 inch water gage) at an airflow of 10.16 meters per second (2,000 fpm). Station construction shall be suitable for operation at airflow of up to 25.4 meters per second (5,000 fpm) over a temperature range of 4 to 49 degrees C (20 to 120 degrees F), and accuracy shall be plus or minus 3 percent over a range of 0.635 to 12.7 meters per second (125 to 2,500 fpm) scaled to air volume.

b. Each transmitter shall produce a linear, temperature compensated 4 to 20 mA or 0 to 10 VDC output corresponding to the actual air flow. The transmitter shall be a 2-wire, loop powered device. The output error of the transmitter shall not exceed 0.5 percent of the calibrated measurement.

2.2.8 Energy Metering

2.2.8.1 Electric Meters

Provide LonMark/LonWorks kilowatt-hour (kWh) meter for building as indicated or specified. Integrate electric meter signal into DDC system; meter signal output must be compatible with DDC input. DDC shall measure both instantaneous and accumulated electrical usage.

- a. Meter: ANSI C12.10. Provide watt-hour meter and socket corresponding to the ratios of the current transformers and transformer secondary voltage. Meters shall be selected for the building voltage, phase, four-wire wye system, three-element type with three current transformers. Meters shall be complete with a box mounted socket having automatic circuit closing bypass. Provide watt-hour meter with not less than four pointer-type kWh registers, provisions for pulse initiation, and a universal Class 2 indicating maximum kW demand register, sweep pointer indicating type, with a 30-minute interval. Meter accuracy shall be within plus or minus one percent. The correct multiplier shall be provided on face of meter.
- b. Current Transformers: ANSI C57.13. Provide three current transformers with 600-volt insulation, rated for metering with voltage, BIL, momentary, and burden ratings coordinated with the ratings of the associated meters. Provide a butyl molded donut or window type transformers mounted on a bracket to allow secondary cables to connect to the transformer bushings. Identify the wiring of the current transformer secondary feeders to permit field current measurements to be taken with hook-on ammeters.

2.3 OUTPUT HARDWARE

2.3.1 Dampers

Damper shall conform to SMACNA DCS.

- a. A single damper section shall have blades no longer than 1220 mm (48 inches) and shall be no higher than 1830 mm (72 inches). Maximum damper blade width shall be 203 mm (8 inches). Larger sized damper shall be made from a combination of sections.
- b. Dampers shall be steel, or other materials where shown. Flat blades shall be made rigid by folding the edges. Blades shall be provided with compressible seals at points of contact. The channel frames of the dampers shall be provided with jamb seals to minimize air leakage. Dampers shall not leak in excess of 102 L/s per square meter (20 cfm per square foot) at 996 Pa (4 inches water) gage static pressure when closed. Seals shall be suitable for an operating temperature range of minus 40 degrees C to 93 degrees C (40 degrees F to 200 degrees F). Dampers shall be rated at not less than 10 m/s (2000 fpm) air velocity. All blade-operating linkages shall be within the frame so that blade-connecting devices within the same damper section will not be located directly in the air stream. Damper axles shall be 13 mm (0.5 inch) (minimum) plated steel rods supported in the damper frame by stainless steel or bronze bearings. Blades mounted vertically shall be supported by thrust bearings. Pressure drop through dampers shall not exceed 10 Pa gage at 5 m/s (0.04 inch water gage at 1000 fpm) in the wide-open position. Frames shall not be less than 50 mm (2 inches) in width. Dampers shall be tested in accordance with AMCA 500.
- c. Operating links external to dampers (such as crankarms, connecting rods, and line shafting for transmitting motion from damper actuators to dampers) shall withstand a load equal to twice the maximum required damper-operating force. Rod lengths shall be adjustable. Links shall be brass, bronze, zinc-coated steel, or stainless steel. Moving parts in contact with one another shall be of different materials. Working parts of joints and

clevises shall be brass, bronze, or stainless steel. Adjustments of crankarms shall control the open and closed position of dampers.

2.3.2 Valves

2.3.2.1 Valve Assembly

Valves shall have stainless steel stems. Valve bodies shall be designed for not less than 862 kPa (gage) (125 psig) working pressure or 150 percent of the system operating pressure, whichever is greater. Valve leakage rating shall be 0.01 percent of rated Cv. Class 125 copper alloy valve bodies and Class 150 steel or stainless steel valves shall conform to ASME/ANSI B16.5 as a minimum. Cast iron valve components shall conform to ASTM A 126 Class B or C as a minimum.

2.3.2.2 Butterfly Valve Assembly

Butterfly valves shall be threaded lug type suitable for dead-end service and for modulation to the fully closed position, with noncorrosive discs, stainless steel shafts supported by bearing, and EPDM seats suitable for temperatures from minus 29 degrees C to plus 121 degrees C (minus 20 degrees F to plus 250 degrees F). Valves shall have a manual means of operation independent of the actuator.

2.3.2.3 Two-Way Valves

Two-way modulating valves shall have equal percentage characteristics.

2.3.2.4 Three-Way Valves

Three-way valves shall have equal percentage characteristics.

2.3.2.5 Duct Coil and Terminal Unit Coil Valves

Provide control valves with either flare-type or solder-type ends provided for duct or terminal-unit coils. Provide flare nuts for each flare-type end valve.

2.3.2.6 Valves for Chilled Water, Condenser Water and Glycol Service

a. Bodies for valves 40 mm (1 1/2 inches) and smaller shall be brass or bronze, with threaded or union ends. Bodies for valves from 50 to 80 mm (2 inches to 3 inches) inclusive shall be of brass, bronze or iron. Bodies for 50 mm (2 inch) valves shall have threaded ends. Bodies for valves from 65 to 80 mm (2 1/2 to 3 inches) shall have flanged-end connections. Internal valve trim shall be brass or bronze except that valve stems may be Type 316 stainless steel. Water valves shall be sized for a 21 kPa (3 psi) differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.

b. Valves 100 mm (4 inches) and larger shall be butterfly valves.

2.3.2.7 Valves for Hot Water Service

Valves for hot water service below 121 degrees C (250 Degrees F):

- a. Bodies for valves 40 mm (1 1/2 inches) and smaller shall be brass or bronze with threaded or union ends. Bodies for valves larger than 50 mm (2 inches) shall have flanged-end connections. Water valves shall be sized for a 21 kPa (3 psi) differential through the valve at rated flow, except as indicated otherwise. Select valve flow coefficient (Cv) for an actual pressure drop not less than 50 percent or greater than 125 percent of the design pressure drop at design flow.
- b. Internal trim, including seats, seat rings, modulation plugs, and springs, of valves controlling water hotter than 99 degrees C (210 degrees F) shall be Type 316 stainless steel.
- c. Internal trim for valves controlling water 99 degrees C (210 degrees F) or less shall be brass or bronze.
- d. Non-metallic parts of hot water control valves shall be suitable for a minimum continuous operating temperature of 121 degrees C or 28 degrees C (250 degrees F or 50 degrees F) above the system design temperature, whichever is higher.
- e. Valves 100 mm (4 inches) and larger shall be butterfly valves.

2.3.3 Actuator

2.3.3.1 Electric Actuators

Provide direct drive electric actuators for all control applications. When operated at rated voltage, each actuator shall be capable of delivering torque required for continuous uniform motion and shall have end switch to limit travel, or shall withstand continuous stalling without damage. Actuators shall function properly with range of 85 to 110 percent of line voltage. Provide gears of steel or copper alloy. Fiber or reinforced nylon gears may be used for torque less than 1.8 Newton meters (16 inch pounds). Provide hardened steel running shafts in sleeve bearing of copper alloy, hardened steel, nylon, or ball bearing. Provide two-position actuators of the single direction, spring return, or reversing type. Provide proportioning actuators capable of stopping at all points in the cycle and starting in either direction, from any point. Provide reversing and proportioning actuators with limit switches to limit travel in either direction unless operator is stall type. Actuators shall have a simple switch for reversing direction, and a button to disengage clutch for manual adjustments. Provide reversible shaded pole, split capacitor, synchronous, or stepper type electric motors.

2.3.3.2 Pneumatic Actuators

Provide piston or diaphragm type actuator with full range or split range springs to provide required sequence specified and fail safe operation.

2.3.4 Output Signal Conversion

2.3.4.1 Electronic to Pneumatic Transducer

Electronic to pneumatic transducer shall convert 4 to 20 mA or 0 to 10 VDC digital controller output signal to a proportional 0 to 20 psig pressure signal (operator scaleable). Accuracy shall be 1.0 percent or better. Linearity shall be 0.1 percent. Transducer shall have feedback circuit that converts pneumatic signal to a proportional 4 to 20 mA or 0 to 10 VDC signal.

2.3.4.2 Pneumatic to Electronic Pressure Transducer

Pneumatic to electronic transducer shall convert 0 to 20 psig signal to a proportional 4 to 20 mA or 0 to 10 VDC signal (operator scaleable). Supply voltage shall be 24 VDC. Accuracy shall be 1.0 percent or better. Linearity shall be 0.1 percent.

2.3.5 Output Switches

2.3.5.1 Control Relays

Shall be double pole, double throw (DPDT), UL listed, with contacts rated to the application, indicator light, and dust proof enclosure. Light indicator is lit when coil is energized and is off when coil is not energized. Relays shall be socket type, plug into a fixed base, and replaceable without need of tools or removing wiring. Encapsulated "PAM" type relays are permissible for terminal control applications.

2.3.5.2 Solenoid Air Valves

Each valve shall have three port operation: common, normally open, and normally closed. Internal parts shall be brass, bronze, or stainless steel. Valves shall be rated at 344 kPa (50 psig) minimum when used in a control system operating at 172 kPa (25 psig) or less, or 1034 kPa (150 psig) when used in a control system operating in the range 172 to 689 kPa (25 to 100 psig).

2.4 ELECTRICAL POWER AND DISTRIBUTION

For control power provide a new, dedicated source 120 volts or less, 60 Hz, three wire (black, white, and green). Run green ground wire to panel ground; conduit grounds are not sufficient.

2.4.1 Transformers

Transformers shall conform to UL 506. Power digital controllers and terminal control units (TCU's) from dedicated circuit breakers with surge protection specified. Transformers for digital controllers serving terminal equipment on lower level LANs may be grouped to have specified surge protection sized for the number of controllers on a single transformer. Provide a fuse on the secondary side of the transformer.

2.4.2 Surge Protection

Surge and transient protection consist of devices installed externally to digital controllers.

2.4.2.1 Power Line Surge Protection

Surge suppressors external to digital controller, shall be installed on all incoming AC power. Surge suppressor shall be rated by UL 1449, have a fault indicating light, and have clamping voltage ratings below the following levels:

- a. Unit is a transient voltage surge suppressor 120 VAC/1 phase/2 wire plus ground, hard wire individual equipment protector.
- b. Unit must react within 5 nanoseconds and automatically reset.
- c. Voltage protection threshold, line to neutral, starts at no more than 211 volts peak on the 120 VAC line.

- d. The transient voltage surge suppressor must have an independent secondary stage equal to or greater than the primary stage joule rating.
- e. The primary suppression system components must be pure Silicon Avalanche Diodes.
- f. Silicon Avalanche Diodes or Metal Oxide Varistors are acceptable in the independent secondary suppression system.
- g. The Transient Suppression System shall incorporate an indication light which denotes whether the primary and/or secondary transient protection components is/are functioning.
- h. All system functions of the Transient Suppression System must be individually fused and not short circuit the AC power line at any time.
- i. The Transient Suppression System shall incorporate an EMI/RFI noise filter with a minimum attenuation of 13 dB at 10 kHz to 300 MHz.
- j. The system must comply with IEEE C62.41, Class "B" requirements and be tested according to IEEE C62.45.
- k. The system shall operate at -20 to +50 degrees C (-4 to 122 degrees F).

2.4.2.2 Telephone and Communication Line Surge Protection

Provide transient surge protection to protect the DDC controllers and LAN related devices from surges that occur on the phone lines (modem or direct connect) and on inter-unit LAN communications. Devices shall be UL listed.

- a. The surge protection shall be a rugged package with continuous, non-interrupting protection and not use crowbar technology. Instant automatic reset after safely eliminating transient surges, induced lightning, and other forms of transient over voltages.
- b. Unit must react within 5 nanoseconds using only solid-state silicone avalanche technology.
- c. Unit shall be installed at the proper distance as recommended by the manufacturer.

2.4.2.3 Controller Input/Output Protection

Controller input/output points shall surge protection with optical isolation, metal oxide varistors (MOV), or silicon avalanche devices. Fuses are not permitted for surge protection.

2.4.3 Wiring

Provide complete electric wiring for DDC System, including wiring to transformer primaries. Control circuit wiring shall not run in the same conduit as power wiring over 100 volts. Circuits operating at more than 100 Volts shall be in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Circuits operating at 100 Volts or less shall be defined as low voltage and shall be run in rigid or flexible conduit, metallic tubing, metal raceways or wire trays, armored cable, or multi-conductor cable. Provide circuit and wiring protection as required by NFPA 70. Aluminum-sheathed cable or aluminum conduit may be used but shall not be buried in concrete. Use conduit or plenum-rated cable in HVAC plenums. HVAC plenums include the space between a drop ceiling and the architectural ceiling, within walls, and within ductwork. Protect exposed wiring from abuse and damage.

2.4.3.1 AC Control Wiring

- a. Control wiring for 24 V circuits shall be insulated copper 18 AWG minimum and rated for 300 VAC service.
- b. Wiring for 120 V shall be 14 AWG minimum and rated for 600 V service.

2.4.3.2 Analog Signal Wiring

Analog signal wiring shall be 18 AWG single or multiple twisted pair. Each cable shall be 100 percent shielded, and have 20 AWG drain wire. Each wire shall have insulation rated to 300 V ac. Cables shall have an overall aluminum-polyester or tinned-copper (cable-shield tape). Install analog signal wiring in conduit separate from AC power circuits.

2.5 FIRE PROTECTION DEVICES

Provide smoke detectors in return and supply air ducts on downstream side of filters in accordance with NFPA 90A, except as otherwise indicated. Provide UL listed or FM approved detectors for duct installation.

2.5.1 Smoke Detectors

Provide in systems having air handling capacity over 944 l/s (2,000 cfm) in accordance with NFPA 90A. Design for detection of abnormal smoke densities by the ionization or photoelectric principle, responsive to both invisible and visible particles of combustion, and not susceptible to operation by changes to relative humidity. Provide UL listed or FM approved detectors for duct installation. Provide duct detectors with an approved duct housing, mounted exterior to duct, and with perforated sampling tubes extending across width of duct. Provide 115 V ac power supply unit integral with duct housing. Duct smoke detectors shall conform to the requirements of UL 268A. Duct smoke detectors shall have perforated sampling tubes extended into the air duct. Detector circuitry shall be mounted in a metallic enclosure exterior to the duct. Detectors shall have manual reset. Detectors shall be rated for air velocities that include air flows between 2.5 and 20 m/s. 500 and 4000 fpm. Detectors shall be powered from the HVAC control panel. Detectors shall have two sets of normally open alarm contacts and two sets of normally closed alarm contacts. Detectors shall be connected to the building fire alarm panel for alarm initiation. A remote annunciation lamp and accessible remote reset switch shall be provided for duct detectors that are mounted eight feet or more above the finished floor and for detectors that are not readily visible. Remote lamps and switches as well as the affected fan units shall be properly identified in etched rigid plastic placards.

Detectors shall have test port or test switch. Provide each detector with a visible indicator lamp that lights when detector is activated. Activation of duct detector shall cause shutdown of associated air handling unit and closing of dampers and shall sound an alarm bell, minimum 6 inch diameter in a normally occupied area located as directed. Provide a separate bell for each air handling unit, with an engraved plastic or metal label indicating which unit each bell annunciates.

2.6 INDICATORS

2.6.1 Thermometers

2.6.2 Pressure Gages

- a. Provide pressure gages for all pneumatic outputs. Select gage range so normal pressures are approximately equal to the midpoint readings on the scale, unless otherwise

specified. Accuracy shall be plus or minus 2 percent of the range. Gages shall conform to ANSI/ASME B40.1.

b. Gages indicating pneumatic outputs shall have 2 inch diameter faces. Scale shall be 0 to 207 kPa (0 to 30 psi), with 7 kPa (1 psi) graduations.

c. Gages for low differential pressure measurements shall be 4 1/2 inch (nominal) size with two sets of pressure taps, and shall have a diaphragm actuated pointer, white dial with black figures, and pointer zero adjustment. Gage shall have ranges and graduations as appropriate for the application, or as shown. Accuracy shall be plus or minus 2 percent of scale range.

2.7 PNEUMATIC POWER SUPPLY AND TUBING

2.7.1 Air Compressors

Provide tank mounted, duplex, electric motor driven, oil type, air cooled, reciprocating type air compressor including motor, controller, pressure switch, belt guard, pressure relief valve, and automatic moisture drain valve. Piston speed shall not exceed 137 meters/min (450 fpm). Set relief valve for 69 to 172 kPa (10 to 25 psig) above the control switch cut-off pressure. Pressure switch shall start compressor at 482 kPa (70 psig) and stop compressor at 620 kPa (90 psig). Size each compressor to run not more than 33 percent of the time with full system control load. Compressor shall have maintaining type starter for automatic restart after power failure. Provide duplex air compressors with electric alternator switch assembly. Motors 0.5 hp and larger shall be three-phase, 208 or 460-volt, 60 Hz.

2.7.2 Compressed Air Tank

Provide steel tank constructed and labeled in accordance with ASME BPVC SEC VIII for a minimum of 1378 kPa (200 psig) working pressure.

2.7.3 Intake Air Filter and Silencer

Provide dry-type combination intake air filter and silencer with baked enamel steel housing. Filter shall be 99 percent efficient at 10 micron rating.

2.7.4 Refrigerated Air Dryer

a. Provide a refrigerant dryer sized for continuous operation to reduce the compressed air dew point temperature, at 138 kPa (20 psig) output pressure, to 30 degrees F with average tank pressure of 551 kPa (80 psig) and ambient air temperature between 12.7 and 35 degrees C (55 and 95 degrees F). Provide dryer with an automatic condensate drain trap with a manual override feature. Provide refrigerant gages for suction lines.

b. Connect dryer in the high pressure piping between tank and pressure-reducing valve.

2.7.5 Compressed Air Discharge Filter

a. Provide dry type filter, 99 percent efficient in removing oil and solid particles at 0.03 micron rating, with baked enamel steel housing and manual drain valve. Provide visual indicator to show when oil filter element should be changed.

- b. Provide disposable filter directly before each control module with pneumatic outputs. Disposable filter shall eliminate 99.99 percent of all liquid or solid contaminants 0.1 micron or larger. Provide filter with easy to remove fittings.

2.7.6 Air Pressure-Reducing Station

Provide pressure-reducing valve (PRV) with field adjustable range of 0 to 344 kPa (0 to 50 psig) discharge pressure, with inlet pressure of 483 to 620 kPa (70 to 90 psig). Provide factory-set pressure relief valve to relieve overpressure downstream of PRV exceeding 172 kPa (25 psig). Provide inlet pressure gage with range of 0 to 689 kPa (0 to 100 psig) and outlet pressure gage with range of 0 to 207 kPa (0 to 30 psig). For two pressure systems, provide an additional PRV and outlet pressure gage.

2.7.7 Pneumatic Tubing

2.7.7.1 Copper Tubing

Provide ASTM B 75 or ASTM B 88M (ASTM B 88) rated tubing. Tubing 9.52 mm (0.375 inch) outside diameter and larger shall have minimum wall thickness equal to ASTM B 88M (ASTM B 88), Type M. Tubing less than 9.52 (0.375 inch) outside diameter shall have minimum wall thickness of 0.635 mm (0.025 inch). Concealed tubing shall be hard or soft copper; multiple tubing shall be racked or bundled. Exposed tubing shall be hard copper; rack multiple tubing. Tubing for working pressures greater than 207 kPa (30 psig) shall be hard copper. Bundled tubing shall have each tube numbered each 1.82 meter (six feet) minimum. Racked and individual tubes shall be permanently identified at each end. Fittings shall be solder type ANSI B16.18 or ASME/ANSI B16.22, using ASTM B 32, 95-5 tin-antimony solder, or compression type ASME/ANSI B16.26.

2.7.7.2 Polyethylene Tubing

Provide flame-resistant, multiple polyethylene tubing in flame-resistant protective sheath, or unsheathed polyethylene tubing in rigid metal, intermediate metal, or electrical metallic tubing conduit for areas where tubing is exposed. Single, unsheathed, flame-resistant polyethylene tubing may be used where concealed in walls or above ceilings and within control panels. Provide polyethylene tubing only for working pressures of 207 kPa (30 psig) or less. Number each tube in sheathing each two feet minimum. Permanently identify unsheathed tubing at each end. Fittings shall be compression or barbed push-on type. Extruded seamless polyethylene tubing shall conform to the following:

- a. Minimum Burst Pressure Requirements: 689 kPa at 23.8 degrees C (100 psig at 75 degrees F) to 172 kPa at 65.5 degrees C (25 psig at 150 degrees F);
- b. Stress Crack Resistance: ASTM D 1693, 200 hours minimum;
- c. Tensile Strength (Minimum): ASTM D 638, 7584 kPa (1100 psi);
- d. Flow Rate (Average): ASTM D 1238, 0.30 decigram per minute; and
- e. Density (Average): ASTM D 792, 920 kg/m³.

2.8 VARIABLE FREQUENCY 3 PHASE MOTOR DRIVES

The variable frequency drive (VFD) shall convert 208 or 460 volt (+/- 10%), three phase, 60 hertz (+/- 2Hz), utility grade power to adjustable voltage/frequency, three phase, AC power for stepless motor control from 5% to 105% of base speed.

2.8.1 Description

The variable frequency drive (VFD) shall produce an adjustable AC voltage/ frequency output for complete motor speed control. The VFD must meet all of the following criteria.

- a. The VFD shall use sinecoded PWM technology. The sinecoded PWM calculations are performed by the VFD microprocessor.
- b. The VFD shall use IGBT transistors for the inverter's three phase output.
- c. The VFD shall use a three phase diode bridge converter to charge the VFD constant voltage capacitor buss.
- d. The VFD shall have the ability for control by either a remote 4-20 mA or 0 to 10 VDC control signal or from a local control panel located on the VFD itself.
- e. The VFD shall use microprocessor technology for VFD control. The VFD shall be programmable with a permanently mounted keypad included with each VFD.
- f. The VFD shall be fully self diagnostic. No external programmers, analyzers, interrogators, or diagnostic boards, shall be needed to annunciate VFD faults or drive internal status.

2.8.2 Code Standards

VFD shall be UL listed as delivered to the end user. The VFD shall meet current National Electrical Code.

2.8.3 VFD Quality Assurance

To ensure quality, each and every VFD shall be subject to a series of in-plant quality controlled inspections before approval for shipment from the manufacture's facilities.

- a. All components shall be tested prior to assembly and the complete unit shall be tested under full load conditions to ensure maximum product reliability.
- b. The VFDs shall be the current standard production unit with at least 10 identical units already in the field.
- c. Engineering support shall be available from the factory of the VFD. Phone support shall be free of charge to the end user for the life of the equipment. Factory support shall be available in the English language.

2.8.4 VFD Service

The VFD shall be supplied with:

- a. 24 month parts and labor warranty. The warranty shall start when the system is accepted by the end user or 30 months from date of shipment.
- b. Installation, operation, and troubleshooting guide(s).

- c. A district service support group shall provide the following additional services:
 - (1) Factory trained personal on-site for start-up for up to one working day at no additional cost. Personnel shall be competent in operation and repair of the particular model of VFD that is installed.
 - (2) On-site training of customer personnel in basic installation, troubleshooting, and operation of VFDs at no additional cost. This training shall be conducted for up to 6 personnel at the installation site for a minimum of 4 hours.

2.8.5 Basic VFD Features

The VFD shall have the following basic features with no more than three separate internal electronic boards.

- a. VFD mounted operator control keypad capable of:
 - (1) Remote/Local operator selection with password access.
 - (2) Run/Stop and manual speed commands.
 - (3) All programming functions.
 - (4) Scrolling through all display functions.
- b. Digital display capable of indicating:
 - (1) VFD status.
 - (2) Frequency.
 - (3) RPM of motor.
 - (4) Phase current.
 - (5) Fault diagnostics in descriptive text.
 - (6) All programmed parameters.
- c. Standard PI loop controller with input terminal for controlled variable and parameter settings made while inverter running.
- d. User interface terminals for end-user remote control of VFD speed, speed feedback, and isolated form C SPDT relay energized on drive fault condition.
- e. An isolated form C SPDT auxiliary relay energized on run command.
- f. The VFD shall have a metal NEMA 1 enclosure.
- g. The VFD shall have an adjustable carrier frequency with 16 KHz minimum upper limit.

- h. The VFD shall have a built in or external line reactor with 3% minimum impedance to protect DC buss capacitors and rectifier section diodes.

2.8.6 Programmable Parameters

The VFD shall include the following operator programmable parameters:

- a. Upper limit frequency.
- b. Lower limit frequency.
- c. Acceleration rate.
- d. Deceleration rate.
- e. Variable torque volts per Hertz curve.
- f. Starting voltage level.
- g. Starting frequency level.
- h. Display speed scaling.
- i. Enable/disable auto-restart feature.
- j. Enable/disable softstall feature.
- k. Motor overload level.
- l. Motor stall level.
- m. Jump frequency and hysteresis band.
- n. PWM carrier frequency.

2.8.7 Protective Circuits and Features

- a. An electronic adjustable inverse time current limit with consideration for additional heating of the motor at frequencies below 45Hz, for the protection of the motor.
- b. An electronic adjustable soft stall feature, allowing the VFD to lower the frequency to a point where the motor will run at FLA when an overload condition exists at the requested frequency. The VFD will automatically return to the requested frequency when load condition permit.
- c. The VFD will have a separate electronic stall at 110% VFD rated current and a separate hardware trip at 190% current.
- d. The VFD shall have ground fault protection that protects output cables and motor from grounds during both starting and continuous running conditions.

- e. The VFD shall have the ability to restart after the following faults:
 - (1) Overcurrent (drive or motor).
 - (2) Power outage.
 - (3) Phase loss.
 - (4) Overvoltage/Undervoltage.
- e. The VFD shall restart into a rotating load without tripping or damaging the VFD or the motor.
- f. The VFD shall keep a log of a minimum of four previous fault conditions, indicating type and time of occurrence in descriptive text.
- g. The VFD shall be able to sustain 110% rated current for 60 sec.
- h. The VFD shall respond to and record the following fault conditions:
 - (1) Over current (and have an indication if the over current was during acceleration, deceleration, or running).
 - (2) Overcurrent internal to the drive.
 - (3) Motor overload at start-up.
 - (4) Over voltage from the utility power.
 - (5) Motor running overload.
 - (6) Overvoltage during deceleration.
 - (7) VFD over heat.
 - (8) Load end ground fault.
 - (9) Abnormal parameters or data in VFD EEPROM.

2.8.8 Operational Conditions

The VFD shall be designed and constructed to operate within the following service conditions.

- a. Ambient Temperature Range, -17.7 to 48.8 degrees C (0 to 120 deg. F).
- b. Non-condensing relative humidity to 90%.

2.8.9 Available Options

Provide the following options:

- a. RFI/EMI filters
- b. RS232 or RS422/485 interface card with application software which can both control and monitor the VFD from a attached computer. Provide LonMark/LonWorks or BACnet interface cards when required by specifications or sequence of operations.
- c. A manual bypass circuit and switch integral or external to the drive to allow drive bypass drive and operate at 100% speed. Overload fuses and other protective hardware shall remain in the circuit during bypass.
- d. One set of spare parts per drive including: all replaceable circuit cards, power diode assemble, DC Buss capacitor, power output transistor assembly, all fuses, and all lights. Package parts individually for long term storage and clearly label contents.

PART 3 EXECUTION

3.1 INSTALLATION

Perform installation under supervision of competent technicians regularly employed in the installation of DDC systems.

3.1.1 Wiring Criteria

- a. Input/output identification: Permanently label each field wire, cable, or pneumatic tube at each end with unique descriptive identification.
- b. Rigid or flexible conduit shall be terminated at all sensors and output devices.
- c. Surge Protection: Install surge protection per manufacturer's specification.
- d. Grounding: Ground controllers and cabinets to a good earth ground. Ground controller to a ground in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Grounding of the green ac ground wire, at the breaker panel, alone is not adequate. Run metal conduit from controller panels to adequate building grounds. Ground sensor drain wire shields at controller end.
- e. Contractor is responsible for correcting all associated ground loop problems.
- d. Wiring in panel enclosures shall be run in covered wire track.

3.1.2 Digital Controllers

- a. Do not divide control of a single mechanical system such as an air handling unit, boiler, chiller, or terminal equipment between two or more controllers. A single controller shall manage control functions for a single mechanical system. It is permissible, however, to manage more than one mechanical system with a single controller.
- b. Provide digital control cabinets that protect digital controller electronics from dust, at locations shown on the drawings.

3.1.3 Temperature Sensors

Provide temperature sensors in locations to sense the appropriate condition. Provide sensor where they are easy to access and service without special tools. Calibrate sensors to accuracy specified. In no case will sensors designed for one application be installed for another application.

3.1.3.1 Room Temperature Sensors

Provide on interior walls to sense average room temperature conditions. Avoid locations near heat sources or which may be covered by office furniture. Room temperature sensors should not be mounted on exterior walls when other locations are available. Mount center of sensor at 5 feet above finished floor.

3.1.3.2 Duct Temperature Sensors

- a. Provide sensors in ductwork in general locations as indicated. Select specific sensor location within duct to accurately sense appropriate air temperatures. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Install gaskets between the sensor housing and duct wall. Seal duct and insulation penetrations.
- b. String duct averaging sensors between two rigid supports in a serpentine position to sense average conditions. Insulate temperature sensing elements from supports. Provide hinged duct access doors to install averaging sensors if needed.
- c. Locate freeze protection sensors in appropriate locations to sense lowest temperatures, to avoid potential problems with air stratification.

3.1.3.3 Immersion Temperature Sensors

Provide thermowells for sensors measuring temperatures in liquid applications or pressure vessels. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in piping at elbows to sense flow across entire area of well. Wells shall not restrict flow area to less than 70 percent of pipe area. Increase piping size as required to avoid restriction. Provide thermowells with thermal transmission material within the well.

3.1.3.4 Outside Air Temperature Sensors

Provide outside air temperature sensor in weatherproof enclosure on north side of the building, away from exhaust hoods, air intakes and other areas that may affect temperature readings. Provide sunshields to from direct sunlight.

3.1.4 Damper Actuators

Actuators shall not be mounted in the air stream.

3.1.5 Thermometers

Provide thermometers at locations indicated. Mount thermometers to allow reading when standing on the floor.

3.1.6 Pressure Sensors

3.1.6.1 Differential Pressure

- a. Duct Static Pressure Sensing: Locate duct static pressure tip approximately two-thirds of distance from supply fan to end of duct with the greatest pressure drop.
- b. Pumping Proof with Differential Pressure Switches: Install high pressure side between pump discharge and check valve.
- c. Steam Pressure Sensing: Install snubbers and isolation valves on steam pressure sensing applications.

3.1.7 Pressure Gages

Pneumatic output lines shall have pressure gages mounted near the digital controllers.

3.1.8 Pneumatic Tubing

Run concealed tubing in finished areas, and run exposed tubing in unfinished areas such as mechanical equipment rooms. For tubing to be enclosed in concrete, provide rigid metal conduit or intermediate metal conduit. Provide tubing parallel and perpendicular to building walls throughout. Maximum spacing between tubing supports shall be 1.5 meters (5 feet). With the compressor turned off, test each tubing system pneumatically at 1.5 times the working pressure, with a maximum pressure drop of 7 kPa (1 psig). Correct leaks. Caulking of joints will not be permitted. Do not run tubing and electrical power conductors in the same conduit.

3.1.9 Control Drawings

- a. Post laminated copies of as-built control system drawings in each mechanical room.
- b. Provide 3 sets of as-built control drawings to the Contracting Officer.

3.2 TEST AND BALANCE SUPPORT

Controls contractor will coordinate with and provide full time on-site technical support to test and balance (TAB) personnel specified under Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS or any other documents in the project specification. This support shall include:

- a. On-site operation of control systems for proper operating modes during all phases of balancing and testing.
- b. Control setpoint adjustments for proper balancing of all relevant mechanical systems, including VAV boxes.
- c. Setting all control loops with setpoints and adjustments determined by TAB personnel.

3.3 FIELD QUALITY CONTROL

3.3.1 General

- a. Demonstrate compliance of the heating, ventilating, and air conditioning control system with the contract documents. Furnish personnel, equipment, instrumentation, and supplies necessary to perform calibration and site testing. Ensure that test personnel are regularly employed in the testing and calibration of DDC systems.
- b. Testing will include the field tests and the performance verification tests. Field tests shall demonstrate proper calibration of input and output devices, and the operation of specific equipment. Performance verification test shall ensure proper execution of the sequence of operation and proper tuning of control loops.
- c. Obtain approval of the field test plan and performance verification test plan for each phase of testing before beginning that phase of testing. Give to the Contracting Officer written notification of planned testing at least 30 days prior to test. Notification shall be accompanied by the proposed test procedures. In no case will the Contractor be allowed to start testing without written Government approval of field test plan and performance verification test plan.
- d. Before scheduling the performance verification test, furnish field test documentation and written Certified Statement of Field Test Completion to the Contracting Officer for approval. The statement, certified by the DDC system provider, states that the installed system has been calibrated, tested, and is ready for the performance verification test. Do not start the performance verification test prior to receiving written permission from the Government.
- e. Tests are subject to oversight and approval by the Contracting Officer. The testing shall not be run during scheduled seasonal off-periods of heating and cooling systems.

3.3.2 Test Reporting for Field Testing and Performance Verification Tests

- a. During and after completion of the Field Tests, and again after the Performance Verification Tests, identify, determine causes, replace, repair or calibrate equipment that fails to meet the specification, and submit a written report to the Government.
- b. Document all tests with detailed test results. Explain in detail the nature of each failure and corrective action taken. Provide a written report containing test documentation after the Field Tests and again after the Performance Verification Tests. Convene a test review meeting at the job site to present the results to the Government. As part of this test review meeting, demonstrate by performing all portions of the field tests or performance verification test that each failure has been corrected. Based on the report and test review meeting, the Government will determine either the restart point or successful completion of testing. Do not retest until after receipt of written notification by the Government. At the conclusion of retest, assessment will be repeated.

3.3.3 Contractor's Field Tests

Field tests shall include the following:

3.3.3.1 System Inspection

Observe the HVAC system in its shutdown condition. Check dampers and valves for proper normal positions. Document each position for the test report.

3.3.3.2 Calibration Accuracy and Operation of Inputs Test

Verify correct calibration and operation of input instruments. For each sensor and transmitter, including those for temperature, pressure, humidity, and air quality, record the reading at the sensor or transmitter location using calibrated test equipment. On the same table, record the corresponding reading at the digital controller for the test report. The test equipment shall have been calibrated within one year of use. Test equipment calibration shall be traceable to the measurement standards of the National Institute of Standards and Technology.

3.3.3.3 Actuator Range Adjustment Test

With the digital controller, apply a control signal to each actuator and verify that the actuator operates properly from its normal position to full range of stroke position. Record actual spring ranges and normal positions for all modulating control valves and dampers. Include documentation in the test report.

3.3.3.4 Digital Controller Startup and Memory Test

Demonstrate that programming is not lost after a power failure, and digital controllers automatically resume proper control after a power failure.

3.3.3.5 Surge Protection Test

Show that surge protection, meeting the requirements of this specification, has been installed on incoming power to the digital controllers and on communications lines.

3.3.3.6 Application Software Operation Test

Test compliance of the application software for:

- a. Ability to communicate with the digital controllers, uploading and downloading of control programs
- b. Text editing program: Demonstrate the ability to edit the control program off line.
- c. Reporting of alarm conditions: Force alarms conditions for each alarm, and ensure that workstation receives alarms.
- d. Reporting trend and status reports: Demonstrate ability of software to receive and save trend and status reports.

3.3.4 Performance Verification Tests

Conduct the performance verification tests to demonstrate control system maintains setpoints, control loops are tuned, and controllers are programmed for the correct sequence of operation. Conduct performance verification test during seven days of continuous HVAC and DDC systems operation and before final acceptance of work. Specifically the performance verification test shall demonstrate the following:

3.3.4.1 Execution of Sequence of Operation

Demonstrate the HVAC system operates properly through the complete sequence of operation, for example seasonal, occupied/unoccupied, and warm-up. Demonstrate proper control system response for abnormal conditions by simulating these conditions. Demonstrate hardware interlocks and safeties work. Demonstrate the control system performs the correct sequence of control after a loss of power.

3.3.4.2 Control Loop Stability and Accuracy

Furnish the Government graphed trends of control loops to demonstrate the control loop is stable and that setpoint is maintained. Control loop response shall respond to setpoint changes and stabilize in 3 minutes. Control loop trend data shall be real time and the time between data points shall not be greater than one minute. The contractor shall provide a printer, either the project printer or temporary, at the job site for printing graphed trends. The printer shall remain on the job site throughout Performance Verification Testing to allow printing trends.

3.4 TRAINING

Submit a training course schedule, syllabus, and training materials 14 days prior to the start of training. Furnish a qualified instructor to conduct training courses for designated personnel in the maintenance and operation of the HVAC and DDC system. Orient training to the specific system being installed under this contract. Use operation and maintenance manual as the primary instructional aid in contractor provided activity personnel training. Base training on the Operations and Maintenance manuals and a DDC training manual. Manuals shall be delivered for each trainee with two additional sets delivered for archiving at the project site. Training manuals shall include an agenda, defined objectives and a detailed description of the subject matter for each lesson. Furnish audio-visual equipment and all other training materials and supplies. A training day is defined as 8 hours of classroom or lab instruction, including two 15 minute breaks and excluding lunch time, Monday through Friday, during the daytime shift in effect at the training facility. For guidance, the Contractor should assume the attendees will have a high school education and are familiar with HVAC systems.

3.4.1 DDC Training Phase I

The first class shall be taught for a period of 2 consecutive training days at least 2 weeks prior to the scheduled Performance Verification Test. The first course shall be taught in a government provided facility on base. Training shall be classroom, but have hands-on operation of similar digital controllers. A maximum of 8 personnel will attend this course. Upon completion of this course, each student, using appropriate documentation, should be able to perform elementary operations, with guidance, and describe the general hardware architecture and functionality of the system. This course shall include but not be limited to:

- a. Theory of operation
- b. Hardware architecture
- c. Operation of the system
- d. Operator commands
- e. Control sequence programming
- f. Data base entry
- g. Reports and logs
- h. Alarm reports
- i. Diagnostics

3.4.2 DDC Training Phase II

The second course shall be taught in the field, using the operating equipment at the project sites for a total of 2 consecutive days. A maximum of 8 personnel will attend the course. The course shall consist of hands-on training under the constant monitoring of the instructor. Course content should duplicate DDC Training Phase I course as applied to the installed system. The instructor shall determine the level of the password to be issued to each student before each session. Upon completion of this course, students should be fully proficient in the operation of each system function.

END OF SECTION

SECTION 15990

TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ASSOCIATED AIR BALANCE COUNCIL (AABC)

AABC MN-1 (1989) National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems

NATIONAL ENVIRONMENTAL BALANCING BUREAU (NEBB)

NEBB Procedural Stds (1991) Procedural Standards for Testing Adjusting Balancing of Environmental Systems

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

TAB Schematic Drawings and Report Forms; G

Three copies of the TAB Schematic Drawings and Report Forms, no later than 21 days prior to the start of TAB field measurements.

SD-03 Product Data

TAB Related HVAC Submittals;

A list of the TAB Related HVAC Submittals, no later than 7 days after the approval of the TAB Specialist.

TAB Procedures; G

Proposed procedures for TAB, submitted with the TAB Schematic Drawings and Report Forms.

Calibration;

List of each instrument to be used during TAB, stating calibration requirements required or recommended by both the TAB Standard and the instrument manufacturer and the actual calibration history of the instrument, submitted with the TAB Procedures. The calibration history shall include dates calibrated, the qualifications of the calibration laboratory, and the calibration procedures used.

Systems Readiness Check;

Proposed date and time to begin the Systems Readiness Check, no later than 7 days prior to the start of the Systems Readiness Check.

TAB Execution; G

Proposed date and time to begin field measurements, making adjustments, etc., for the TAB Report, submitted with the Systems Readiness Check Report.

TAB Verification; G

Proposed date and time to begin the TAB Verification, submitted with the TAB Report.

SD-06 Test Reports

Design Review Report; G

A copy of the Design Review Report, no later than 14 days after approval of the TAB Firm and the TAB Specialist.

Systems Readiness Check; G

A copy of completed checklists for each system, each signed by the TAB Specialist, at least 7 days prior to the start of TAB Execution. All items in the Systems Readiness Check Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Report; G

Three copies of the completed TAB Reports, no later than 7 days after the execution of TAB. All items in the TAB Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

TAB Verification Report; G

Three copies of the completed TAB Verification Report, no later than 7 days after the execution of TAB Verification. All items in the TAB Verification Report shall be signed by the TAB Specialist and shall bear the seal of the Professional Society or National Association used as the TAB Standard.

SD-07 Certificates

TAB Firm; G

Certification of the proposed TAB Firm's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Firm or disciplinary action taken by AABC or NEBB against the proposed TAB Firm shall be described in detail.

TAB Specialist; G

Certification of the proposed TAB Specialist's qualifications by either AABC or NEBB to perform the duties specified herein and in other related Sections, no later than 21 days after the Notice to Proceed. The documentation shall include the date that the Certification was

initially granted and the date that the current Certification expires. Any lapses in Certification of the proposed TAB Specialist or disciplinary action taken by AABC or NEBB against the proposed TAB Specialist shall be described in detail.

1.3 SIMILAR TERMS

In some instances, terminology differs between the Contract and the TAB Standard primarily because the intent of this Section is to use the industry standards specified, along with additional requirements listed herein to produce optimal results. The following table of similar terms is provided for clarification only. Contract requirements take precedent over the corresponding AABC or NEBB requirements where differences exist.

SIMILAR TERMS

Contract Term	AABC Term	NEBB Term
TAB Standard Systems.	National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems	Procedural Standards for Testing Adjusting Balancing of Environmental
TAB Specialist	TAB Engineer	TAB Supervisor
Systems Readiness Check	Construction Phase Inspection	Field Readiness Check & Preliminary Field Procedures.

1.4 TAB STANDARD

TAB shall be performed in accordance with the requirements of the standard under which the TAB Firm's qualifications are approved, i.e., AABC MN-1 or NEBB Procedural Stds, unless otherwise specified herein. All recommendations and suggested practices contained in the TAB Standard shall be considered mandatory. The provisions of the TAB Standard, including checklists, report forms, etc., shall, as nearly as practical, be used to satisfy the Contract requirements. The TAB Standard shall be used for all aspects of TAB, including qualifications for the TAB Firm and Specialist and calibration of TAB instruments. Where the instrument manufacturer calibration recommendations are more stringent than those listed in the TAB Standard, the manufacturer's recommendations shall be adhered to. All quality assurance provisions of the TAB Standard such as performance guarantees shall be part of this contract. For systems or system components not covered in the TAB Standard, TAB procedures shall be developed by the TAB Specialist. Where new procedures, requirements, etc., applicable to the Contract requirements have been published or adopted by the body responsible for the TAB Standard used (AABC or NEBB), the requirements and recommendations contained in these procedures and requirements shall be considered mandatory.

1.5 QUALIFICATIONS

1.5.1 TAB Firm

The TAB Firm shall be either a member of AABC or certified by the NEBB and certified in all categories and functions where measurements or performance are specified on the plans and specifications, including building systems commissioning. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the firm loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Firm for approval. Any firm that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC

systems, including TAB. All work specified in this Section and in other related Sections to be performed by the TAB Firm shall be considered invalid if the TAB Firm loses its certification prior to Contract completion and must be performed by an approved successor. These TAB services are to assist the prime Contractor in performing the quality oversight for which it is responsible. The TAB Firm shall be a subcontractor of the prime Contractor, and shall report to and be paid by the prime Contractor.

1.5.2 TAB Specialist

The TAB Specialist shall be either a member of AABC or an experienced technician of the Firm certified by the NEBB. The certification shall be maintained for the entire duration of duties specified herein. If, for any reason, the Specialist loses subject certification during this period, the Contractor shall immediately notify the Contracting Officer and submit another TAB Specialist for approval. Any individual that has been the subject of disciplinary action by either the AABC or the NEBB within the five years preceding Contract Award shall not be eligible to perform any duties related to the HVAC systems, including TAB. All work specified in this Section and in other related Sections performed by the TAB Specialist shall be considered invalid if the TAB Specialist loses its certification prior to Contract completion and must be performed by the approved successor.

1.6 TAB SPECIALIST RESPONSIBILITIES

All TAB work specified herein and in related sections shall be performed under the direct guidance of the TAB Specialist. The TAB Specialist shall participate in the commissioning process specified in Section 15995 COMMISSIONING OF HVAC SYSTEMS.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 DESIGN REVIEW

The TAB Specialist shall review the Contract Plans and Specifications and advise the Contracting Officer of any deficiencies that would prevent the HVAC systems from effectively operating in accordance with the sequence of operation specified or prevent the effective and accurate TAB of the system. The TAB Specialist shall provide a Design Review Report individually listing each deficiency and the corresponding proposed corrective action necessary for proper system operation.

3.2 TAB RELATED HVAC SUBMITTALS

The TAB Specialist shall prepare a list of the submittals from the Contract Submittal Register that relate to the successful accomplishment of all HVAC TAB. The submittals identified on this list shall be accompanied by a letter of approval signed and dated by the TAB Specialist when submitted to the Government. The TAB Specialist shall also ensure that the location and details of ports, terminals, connections, etc., necessary to perform TAB are identified on the submittals.

3.3 TAB SCHEMATIC DRAWINGS AND REPORT FORMS

A schematic drawing showing each system component, including balancing devices, shall be provided for each system. Each drawing shall be accompanied by a copy of all report forms required by the TAB Standard used for that system. Where applicable, the acceptable range of operation or appropriate setting for each component shall be included on the forms or as an attachment to the forms. The schematic drawings shall identify all testing points and cross reference these points to the report forms and procedures.

3.4 DUCTWORK LEAK TESTING

The TAB Specialist shall witness the Ductwork Leak Testing specified in Section 15895 AIR SUPPLY, DISTRIBUTION, VENTILATION, AND EXHAUST SYSTEM and approve the results as specified in Paragraph TAB RELATED HVAC SUBMITTALS.

3.5 TESTING, ADJUSTING, AND BALANCING

3.5.1 TAB Procedures

Step by step procedures for each measurement required during TAB Execution shall be provided. The procedures shall be oriented such that there is a separate section for each system. The procedures shall include measures to ensure that each system performs as specified in all operating modes, interactions with other components (such as exhaust fans, kitchen hoods, fume hoods, relief vents, doors, etc.) and systems, and with all seasonal operating differences, diversity, simulated loads, and pressure relationships required.

3.5.2 Systems Readiness Check

The TAB Specialist shall inspect each system to ensure that it is complete, including installation and operation of controls, and that all aspects of the facility that have any bearing on the HVAC systems, including installation of ceilings, walls, windows, doors, and partitions, are complete to the extent that TAB results will not be affected by any detail or touch-up work remaining. The TAB Specialist shall also verify that all items such as ductwork and piping ports, terminals, connections, etc., necessary to perform TAB shall be complete during the Systems Readiness Check.

3.5.3 Preparation of TAB Report

Preparation of the TAB Report shall begin only when the Systems Readiness Report has been approved. The Report shall be oriented so that there is a separate section for each system. The Report shall include a copy of the appropriate approved Schematic Drawings and TAB Related Submittals, such as pump curves, fan curves, etc., along with the completed report forms for each system. The operating points measured during successful TAB Execution and the theoretical operating points listed in the approved submittals shall be marked on the performance curves and tables. Where possible, adjustments shall be made using an "industry standard" technique which would result in the greatest energy savings, such as adjusting the speed of a fan instead of throttling the flow. Any deficiencies outside of the realm of normal adjustments and balancing during TAB Execution shall be noted along with a description of corrective action performed to bring the measurement into the specified range. If, for any reason, the TAB Specialist determines during TAB Execution that any Contract requirement cannot be met, the TAB Specialist shall immediately provide a written description of the deficiency and the corresponding proposed corrective action necessary for proper system operation to the Contracting Officer.

3.5.4 TAB Verification

The TAB Specialist shall recheck ten percent of the measurements listed in the Tab Report and prepare a TAB Verification Report. The measurements selected for verification and the individuals that witness the verification will be selected by the Contracting Officer's Representative (COR). The measurements will be recorded in the same manner as required for the TAB Report. All measurements that fall outside the acceptable operating range specified shall be accompanied by an explanation as to why the measurement does not correlate with that listed in the TAB Report and a description of corrective action performed to bring the measurement into the specified range. The TAB Specialist shall update the original TAB report to reflect any changes or differences noted in the TAB verification report and submit the updated TAB report. If over 20 percent of the measurements selected by the COR for verification fall outside of the acceptable operating range specified, the COR will select an additional ten percent for verification. If over 20 percent of the total tested (including both

test groups) fall outside of the acceptable range, the TAB Report shall be considered invalid and all contract TAB work shall be repeated beginning with the Systems Readiness Check.

3.5.5 Marking of Setting

Following approval of TAB Verification Report, the setting of all HVAC adjustment devices including valves, splitters, and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.

3.5.6 Identification of Test Ports

The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leakage or to maintain integrity of vapor barrier.

END OF SECTION

SECTION 15995

COMMISSIONING OF HVAC SYSTEMS

PART 1 GENERAL

1.1 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-03 Product Data

Commissioning Team; G

List of team members who will represent the Contractor in the pre-commissioning checks and functional performance testing, at least 2 weeks prior to the start of pre-commissioning checks. Proposed revision to the list, prior to the start of the impacted work.

Test Procedures; G

Detailed procedures for pre-commissioning checks and functional performance tests, at least 4 weeks prior to the start of pre-commissioning checks.

Test Schedule; G

Schedule for pre-commissioning checks and functional performance tests, at least 2 weeks prior to the start of pre-commissioning checks.

SD-06 Test Reports

Test Reports; G

Completed pre-commissioning checklists and functional performance test checklists organized by system and by subsystem and submitted as one package. The results of failed tests shall be included along with a description of the corrective action taken.

1.2 SEQUENCING AND SCHEDULING

The work described in this Section shall begin only after all work required in related Sections, including Section 15910 DIRECT DIGITAL CONTROL SYSTEMS and Section 15990 TESTING, ADJUSTING, AND BALANCING OF HVAC SYSTEMS, has been successfully completed, and all test and inspection reports and operation and maintenance manuals required in these Sections have been submitted and approved. Seismic details shall be in accordance with Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 COMMISSIONING TEAM AND CHECKLISTS

The Contractor shall designate team members to participate in the pre-commissioning checks and the functional performance testing specified herein. In addition, the Government will be represented by a representative of the Contracting Officer, the Design Agent's Representative, and the Using Agency. The team members shall be as follows:

Designation	Function
Q	Contractor's Chief Quality Control Representative
M	Contractor's Mechanical Representative
E	Contractor's Electrical Representative
T	Contractor's Testing, Adjusting, and Balancing Representative
C	Contractor's Controls Representative
D	Design Agent's Representative
O	Contracting Officer's Representative
U	Using Agency's Representative

Each checklist shown in appendices A and B shall be completed by the commissioning team. Acceptance by each commissioning team member of each pre-commissioning checklist item shall be indicated by initials and date unless an "X" is shown indicating that participation by that individual is not required. Acceptance by each commissioning team member of each functional performance test checklist shall be indicated by signature and date.

3.2 TESTS

The pre-commissioning checks and functional performance tests shall be performed in a manner which essentially duplicates the checking, testing, and inspection methods established in the related Sections. Where checking, testing, and inspection methods are not specified in other Sections, methods shall be established which will provide the information required. Testing and verification required by this section shall be performed during the Commissioning phase. Requirements in related Sections are independent from the requirements of this Section and shall not be used to satisfy any of the requirements specified in this Section. The Contractor shall provide all materials, services, and labor required to perform the pre-commissioning checks and functional performance tests. A pre-commissioning check or functional performance test shall be aborted if any system deficiency prevents the successful completion of the test or if any participating non-Government commissioning team member of which participation is specified is not present for the test. The Contractor shall reimburse the Government for all costs associated with effort lost due to tests that are aborted. These costs shall include salary, travel costs and per diem (where applicable) for Government commissioning team members.

3.2.1 Pre-Commissioning Checks

Pre-commissioning checks shall be performed for the items indicated on the checklists in Appendix A. Deficiencies discovered during these checks shall be corrected and retested in accordance with the applicable contract requirements.

3.2.2 Functional Performance Tests

Functional performance tests shall be performed for the items indicated on the checklists in Appendix B. Functional performance tests shall begin only after all pre-commissioning checks have been successfully completed. Tests shall prove all modes of the sequences of operation, and shall verify all

other relevant contract requirements. Tests shall begin with equipment or components and shall progress through subsystems to complete systems. Upon failure of any functional performance test checklist item, the Contractor shall correct all deficiencies in accordance with the applicable contract requirements. The checklist shall then be repeated until it has been completed with no errors.

APPENDIX A

PRE-COMMISSIONING CHECKLISTS

Pre-commissioning checklist - Piping

For Hydronic Piping System

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Piping complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Piping flushed and cleaned.	___	___	X	___	X	___	___	___
d. Strainers cleaned.	___	___	X	___	X	___	___	___
e. Valves installed as required.	___	___	X	___	X	___	___	___
f. Piping insulated as required.	___	___	X	___	X	___	___	___
g. Thermometers and gauges installed as required.	___	___	X	___	X	___	___	___
h. Verify operation of valves.	___	___	X	___	___	___	___	___
i. Air vents installed as specified.	___	___	X	X	X	___	___	___
j. Flexible connectors installed as specified	___	___	X	X	X	___	___	___
k. Verify that piping has been labeled and valves identified as specified.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Hydrostatic test complete.	___	___	X	___	X	___	___	___
b. TAB operation complete.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Ductwork

For Air Handler: For each AHU scheduled

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Ductwork complete.	___	___	X	___	X	___	___	___
b. As-built shop drawings submitted.	___	___	X	___	X	___	___	___
c. Ductwork leak test complete.	___	___	X	___	X	___	___	___

NOTE: The first bracketed item d will be used for Army projects, the second for Air Force projects.

d. Fire dampers, smoke dampers, and access doors installed as required.	___	___	X	___	X	___	___	___]
e. Ductwork insulated as required.	___	___	X	___	X	___	___	___
f. Thermometers and gauges installed as required.	___	___	___	___	___	___	___	___
g. Verify open/closed status of dampers.	___	___	X	___	X	___	___	___
h. Verify smoke dampers operation.	___	___	X	___	___	___	___	___
i. Flexible connectors installed as specified	___	___	X	___	X	___	___	___

Testing, Adjusting, and Balancing (TAB)

a. TAB operation complete.	___	___	X	___	X	___	___	___
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Pre-commissioning Checklist - Multizone Air Handling Unit

For Air Handling Unit: For each AHU scheduled

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed [and freed to float with adequate movement and seismic restraint] as specified.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed. (Visually verify pan drains completely by pouring a cup of water into drain pan.)	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Coils								
a. Hot water piping properly connected.	___	___	X	X	X	___	___	___]
b. Hot water piping pressure tested.	___	___	X	X	X	___	___	___]
c. Air vents installed on water coils [with shutoff valves] as specified.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired	___	___	X	___	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

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- | | | | | | | | | | |
|----|--|----|----|---|----|----|----|----|----|
| c. | O.A. dampers/actuators properly installed. | __ | __ | X | __ | __ | __ | __ | __ |
| d. | O.A. dampers/actuators operable. | __ | __ | X | __ | __ | __ | __ | __ |
| e. | Zone dampers/actuators properly installed. | __ | __ | X | __ | __ | __ | __ | __ |
| f. | Zone dampers/actuators operable. | __ | __ | X | __ | __ | __ | __ | __ |

Testing, Adjusting, and Balancing (TAB)

- | | | | | | | | | | |
|----|--|----|----|---|----|---|----|----|----|
| a. | Construction filters removed and replaced. | __ | __ | X | __ | X | __ | __ | __ |
| b. | TAB report submitted. | __ | __ | X | __ | X | __ | __ | __ |
| c. | TAB results within +10%/-0% of L/s
cfm shown on drawings | | | | | | | | |
| d. | TAB results for outside air intake within
+10%/-0% of L/s (CFM)
shown on drawings. | __ | __ | X | __ | X | __ | __ | __ |

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Pre-commissioning Checklist - Pumps

For Pump: Each scheduled pump

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Pumps grouted in place.	___	___	X	X	X	___	___	___
b. Pump vibration isolation devices functional.	___	___	X	X	X	___	___	___
c. Pump/motor coupling alignment verified.	___	___	X	X	X	___	___	___
d. Piping system installed.	___	___	X	X	X	___	___	___
e. Piping system pressure tested.	___	___	X	X	X	___	___	___
f. Pump not leaking.	___	___	X	X	X	___	___	___
g. Field assembled couplings aligned to meet manufacturer's prescribed tolerances.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to pump disconnect.	___	___	___	X	X	___	___	___
b. Pump rotation verified.	___	___	___	X	X	___	___	___
c. Control system interlocks functional.	___	___	___	X	___	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Pressure/temperature gauges installed.	___	___	X	___	X	___	___	___
b. Piping system cleaned.	___	___	X	X	X	___	___	___
c. Chemical water treatment complete.	___	___	X	X	X	___	___	___
d. Water balance complete.	___	___	X	___	X	___	___	___
e. Water balance with design maximum flow.	___	___	X	___	X	___	___	___
f. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Hot Water Boiler

For Boiler: For each scheduled boiler

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Boiler flue installed.	___	___	X	___	___	___	___	___
b. Boiler hot water piping installed.	___	___	X	___	___	___	___	___
c. Boiler hot water piping tested.	___	___	X	X	___	___	___	___
d. Boiler makeup water piping installed.	___	___	X	___	___	___	___	___
e. Boiler gas piping installed.	___	___	X	X	X	___	___	___
f. Boiler gas piping tested.	___	___	X	X	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	___	___	___	___	___
Startup								
a. Boiler system cleaned and filled with treated water.	___	___	X	___	___	___	___	___
b. Boiler safety/protection devices, including high temperature burner shut-off, low water cutoff, flame failure, pre and post purge, have been tested.	___	___	___	X	___	___	___	___
c. Verify that PRV rating conforms to boiler rating.	___	___	___	X	___	___	___	___
d. Boiler water treatment system functional.	___	___	X	X	___	___	___	___
e. Boiler startup and checkout complete.	___	___	X	X	___	___	___	___
f. Combustion efficiency demonstrated.	___	___	X	___	X	___	___	___
Electrical								
a. Verify that power disconnect is located within sight of the unit served.	___	___	___	X	___	___	___	___
Controls								
a. Hot water pump interlock installed.	___	___	___	X	___	___	___	___
b. Hot water pump interlock tested.	___	___	___	X	___	___	___	___
c. Hot water heating system balanced.	___	___	X	X	___	___	___	___
d. Hot water heating controls operational.	___	___	X	X	___	___	___	___

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Pre-commissioning Checklist - Fan Coil Unit

For Fan Coil Unit: For each scheduled fan

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Access doors/removable panels are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Fan belt adjusted.	___	___	X	___	X	___	___	___
f. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
g. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Coils								
a. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
b. Hot water piping pressure tested.	___	___	X	___	___	___	___	___]
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. Construction filters removed and replaced.	___	___	X	___	___	___	___	___

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b. TAB results +10%/-0% of L/s
(cfm) shown on drawings

c. TAB Report submitted.

___ ___ X ___ X ___ ___ ___

Pre-commissioning Checklist - Unit Heater

For Unit Heater: For each scheduled unit heater

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
b. Hot water piping pressure tested.	___	___	X	___	___	___	___	___]
c. Air vent installed on hot water coil with shutoff valve as specified.	___	___	X	X	X	___	___	___
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
e. Manufacturer's required maintenance/operational clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	X	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
d. Power available to electric heating coil.	___	___	___	X	___	___	___	___
Controls								
a. Control valves properly installed.	___	___	X	___	___	___	___	___
b. Control valves operable.	___	___	X	X	___	___	___	___
c. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Exhaust Fan

For Exhaust Fan: For each scheduled exhaust fan

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Fan belt adjusted.	___	___	X	___	X	___	___	___
Electrical								
a. Power available to fan disconnect.	___	___	___	X	___	___	___	___
b. Proper motor rotation verified.	___	___	___	___	X	___	___	___
c. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
Controls								
a. Control interlocks properly installed.	___	___	___	X	___	___	___	___
b. Control interlocks operable.	___	___	___	X	___	___	___	___
c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___
Testing, Adjusting, and Balancing (TAB)								
a. TAB results +10%/-0% to L/s cfm shown on drawings	___	___	X	___	X	___	___	___
b. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - HVAC System Controls

For HVAC System: For each HVAC system

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. As-built shop drawings submitted.	___	___	X	X	___	___	___	___
b. Layout of control panel matches drawings.	___	___	X	X	___	___	___	___
c. Framed instructions mounted in or near control panel.	___	___	X	X	___	___	___	___
d. Components properly labeled (on inside and outside of panel).	___	___	X	X	___	___	___	___
e. Control components piped and/or wired to each labeled terminal strip.	___	___	X	X	___	___	___	___
f. EMCS connection made to each labeled terminal strip as shown.	___	___	X	X	___	___	___	___
g. Control wiring and tubing labeled at all terminations, splices, and junctions.	___	___	X	X	___	___	___	___
h. Shielded wiring used on electronic sensors.	___	___	X	X	___	___	___	___
i. Air dryer installed as specified.	___	___	X	X	___	___	___	___
j. Water drain installed as specified.	___	___	X	X	___	___	___	___
Main Power and Control Air								
a. 110 volt AC power available to panel.	___	___	___	X	___	___	___	___
b. 138 kPa gauge (20 psig) compressed air available to panel.	___	___	X	X	___	___	___	___
Testing, Commissioning, and Balancing								
a. Testing, Commissioning, and Balancing Report submitted.	___	___	X	___	___	___	___	___

Pre-commissioning Checklist - Single Zone Air Handling Unit

For Air Handling Unit: For each single zone AHU

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Vibration isolation devices installed.	___	___	X	X	X	___	___	___
b. Inspection and access doors are operable and sealed.	___	___	X	___	X	___	___	___
c. Casing undamaged.	___	___	X	X	X	___	___	___
d. Insulation undamaged.	___	___	X	X	X	___	___	___
e. Condensate drainage is unobstructed.	___	___	X	X	X	___	___	___
f. Fan belt adjusted.	___	___	X	___	X	___	___	___
g. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
h. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Electrical								
a. Power available to unit disconnect.	___	___	___	X	X	___	___	___
b. Power available to unit control panel.	___	___	___	X	___	___	___	___
c. Proper motor rotation verified.	___	___	___	___	X	___	___	___
d. Verify that power disconnect is located within sight of the unit it controls.	___	___	___	X	___	___	___	___
e. Power available to electric heating coil.	___	___	___	X	___	___	___	___
Coils								
a. Hot water piping properly connected.	___	___	X	___	___	___	___	___]
b. Hot water piping pressure tested.	___	___	X	X	___	___	___	___]
c. Air vents installed on water coils [with shutoff valves] as specified.	___	___	X	X	X	___	___	___]
d. Any damage to coil fins has been repaired.	___	___	X	___	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

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c. Dampers/actuators properly installed.	___	___	X	___	___	___	___	___
d. Dampers/actuators operable.	___	___	X	___	___	___	___	___
e. Verify proper location and installation of thermostat.	___	___	X	___	___	___	___	___

Testing, Adjusting, and Balancing (TAB)

a. Construction filters removed and replaced.	___	___	X	___	X	___	___	___
b. TAB results +10%/-0% L/s (cfm) shown on drawings.	___	___	X	___	X	___	___	___
c. TAB Report submitted.	___	___	X	___	X	___	___	___

Pre-commissioning Checklist - Energy Recovery System

For Energy Recovery System: For each energy recovery system

Checklist Item	Q	M	E	T	C	D	O	U
Installation								
a. Recovery system piping installed.	___	___	X	___	X	___	___	___
b. Recovery system piping tested.	___	___	X	X	X	___	___	___
c. Face and bypass damper operational.	___	___	X	X	X	___	___	___
d. Manufacturer's required maintenance clearance provided.	___	___	X	X	X	___	___	___
Startup								
a. Recovery system piping cleaned and filled.	___	___	X	X	X	___	___	___
b. Converter startup and checkout complete.	___	___	X	X	X	___	___	___
Controls								
a. Control valves/actuators properly installed.	___	___	X	___	___	___	___	___
b. Control valves/actuators operable.	___	___	X	___	___	___	___	___

APPENDIX B

FUNCTIONAL PERFORMANCE TESTS CHECKLISTS

Functional Performance Test Checklist - Pumps

For Pump: For each scheduled pump

Prior to performing this checklist, ensure that for closed loop systems, system is pressurized and the make-up water system is operational or, for open loop systems, that the sumps are filled to the proper level.

1. Activate pump start using control system commands (all possible combination, on/auto, etc.). ON_____ AUTO_____ OFF_____

a. Verify pressure drop across strainer:

Strainer inlet pressure _____ kPa (____ psig)
Strainer outlet pressure _____ kPa (____ psig)

Strainer inlet pressure _____ kPa (____ psig)
Strainer outlet pressure _____ kPa (____ psig)

b. Verify pump inlet/outlet pressure reading, compare to Testing, Adjusting, and Balancing (TAB) Report, pump design conditions, and pump manufacturer's performance.

	DESIGN	SYSTEM TEST	ACTUAL
Pump inlet pressure kPa gauge (psig)	_____	_____	_____
Pump outlet pressure kPa gauge (psig)	_____	_____	_____

c. Operate pump at shutoff and at 100 percent of designed flow when all components are in full flow. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure kPa gauge (psig)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate L/s (gpm)	_____	_____

d. Operate pump at shutoff and at minimum flow or when all components are in full by-pass. Plot test readings on pump curve and compare results against readings taken from flow measuring devices.

	SHUTOFF	100 percent
Pump inlet pressure (kPa gauge)	_____	_____
Pump outlet pressure	_____	_____
Pump flow rate (L/s)	_____	_____

2. Verify motor amperage each phase and voltage phase to phase and phase to ground for both the full flow and the minimum flow conditions.

a. Full flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

b. Minimum flow:

	PHASE 1	PHASE 2	PHASE 3
Amperage	_____	_____	_____
Voltage	_____	_____	_____
Voltage	_____	_____	_____
Voltage to ground	_____	_____	_____

3. Unusual vibration, noise, etc.

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

Contractor's Mechanical Representative

Contractor's Electrical Representative

Contractor's Testing, Adjusting and Balancing Representative

Contractor's Controls Representative

Contracting Officer's Representative

Using Agency's Representative

Functional Performance Test Checklist - Single Zone Air Handling Unit

For Air Handling Unit: For each scheduled AHU

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the [supply fan operating] [supply and return fans operating] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Hot water control valve modulating to maintain space heating temperature set point input from outside air temperature controller.

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulated to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain space cooling temperature set point. _____

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the [supply fan off] [supply and return fans off] mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) Fan de-energizes. _____

f. Verify cooling coil and heating coil operation by varying thermostat set point from cooling set point to heating set point and returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

Contractor's Mechanical Representative

Contractor's Electrical Representative

Contractor's Testing, Adjusting and Balancing Representative

Contractor's Controls Representative

Contracting Officer's Representative

Using Agency's Representative

Functional Performance Test Checklist - Multizone Air Handling Unit

For Air Handling Unit: For each scheduled Multizone AHU Ensure that a slight negative pressure exists on inboard side of the outside air dampers throughout the operation of the dampers. Modulate OA, RA, and EA dampers from fully open to fully closed positions.

1. Functional Performance Test: Contractor shall verify operation of air handling unit as per specification including the following:

a. The following shall be verified when the supply and return fans operating mode is initiated:

(1) All dampers in normal position. _____

(2) All valves in normal position. _____

(3) System safeties allow start if safety conditions are met. _____

b. Occupied mode of operation - economizer de-energized.

(1) Outside air damper at minimum position. _____

(2) Return air damper open. _____

(3) Relief air damper [at minimum position] [closed]. _____

(4) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller.

c. Occupied mode of operation - economizer energized.

(1) Outside air damper modulates to maintain mixed air temperature set point. _____

(2) Relief air damper modulates with outside air damper according to sequence of operation. _____

(3) Chilled water control valve modulating to maintain cold deck supply air temperature set point. _____

(4) Hot water control valve modulating to maintain hot deck supply air temperature set point input from outside air temperature controller.

d. Unoccupied mode of operation

(1) All dampers in normal position. _____

(2) Verify low limit space temperature is maintained as specified in sequence of operation. _____

e. The following shall be verified when the supply and return fans off mode is initiated:

- (1) All dampers in normal position. _____
- (2) All valves in normal position. _____
- (3) Fan de-energizes. _____

f. Verify zone damper operation by varying zone thermostat set points from cooling set point to heating set point and returning to cooling set point. _____

g. Verify safety shut down initiated by smoke detectors. _____

h. Verify safety shut down initiated by low temperature protection thermostat. _____

i. Index room thermostats to full cooling then to full heating. Measure and record cold deck, hot deck, and supply air temperatures and determine damper leakage for a minimum of 2 zones.

Cold deck temperature _____ degrees C (_____ degrees F)
Hot deck temperature _____ degrees C (_____ degrees F)

Zone _____
Cooling temperature _____ degrees C (_____ degrees F)
Heating temperature _____ degrees C (_____ degrees F)
Damper leakage cooling _____ degrees C (_____ degrees F)
Damper leakage heating _____ degrees C (_____ degrees F)

Zone _____
Cooling temperature _____ degrees C (_____ degrees F)
Heating temperature _____ degrees C (_____ degrees F)
Damper leakage cooling _____ degrees C (_____ degrees F)
Damper leakage heating _____ degrees C (_____ degrees F)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing, Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contracting Officer's Representative _____

02022/DB-ME/SL
FY03 Whole Barracks Renewal, Fort Lewis, WA

Using Agency's Representative

Functional Performance Test Checklist - Hot Water Boiler

For Boiler: For each schedule boiler

1. Functional Performance Test: Contractor shall demonstrate operation of hot water system as per specifications including the following: Start building heating equipment to provide load for boiler. Activate controls system boiler start sequence as follows.

a. Start hot water pump and establish hot water flow. Verify boiler hot water proof-of-flow switch operation. _____

b. Verify control system energizes boiler start sequence. _____

c. Verify boiler senses hot water temperature below set point and control system activates boiler start. _____

d. Shut off building heating equipment to remove load on hot water system. Verify boiler shutdown sequence is initiated and accomplished after load is removed. _____

2. Verify boiler inlet/outlet pressure reading, compare to Test and Balance (TAB) Report, boiler design conditions, and boiler manufacturer's performance data.

	DESIGN	SYSTEM TEST	ACTUAL
Boiler inlet pressure (kPa gauge)	_____	_____	_____
Boiler outlet pressure (kPa gauge)	_____	_____	_____
Boiler flow rate (L/s)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

	DESIGN	SYSTEM TEST	ACTUAL
Boiler inlet pressure (psig)	_____	_____	_____
Boiler outlet pressure (psig)	_____	_____	_____
Boiler flow rate (gpm)	_____	_____	_____
Flue-gas temperature at boiler outlet	_____	_____	_____
Percent carbon dioxide in flue-gas	_____	_____	_____
Draft at boiler flue-gas exit	_____	_____	_____
Draft or pressure in furnace	_____	_____	_____
Stack emission pollutants concentration	_____	_____	_____
Fuel type	_____	_____	_____
Combustion efficiency	_____	_____	_____

3. Record the following information:

Ambient temperature	_____	degrees C (degrees F)
Entering hot water temperature	_____	degrees C (degrees F)
Leaving hot water temperature	_____	degrees C (degrees F)

4. Verify temperatures in item 3 are in accordance with the reset schedule.

5. Verify proper operation of boiler safeties. _____

6. Unusual vibration, noise, etc.

7. Visually check refractory for cracks or spalling and refractory and tubes for flame impingement. _____

8. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

Contractor's Mechanical Representative

Contractor's Electrical Representative

Contractor's Testing, Adjusting and Balancing Representative

Contractor's Controls Representative

Contracting Officer's Representative

Using Agency's Representative

Functional Performance Test Checklist - Fan Coil Units

The Contracting Officer will select fan coil units to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected fan coils as per specifications including the following:

a. Cooling only fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be cooling set point to cooling set point minus 10 degrees and return to cooling set point. _____

(2) Check blower fan air flow. _____ L/s

(3) Check cooling coil water flow. _____ L/s (gpm)

(4) Verify proper operation of cooling water control valve. _____

b. Heating fan coils:

(1) Verify fan coil unit response to room temperature set point adjustment. Changes to be no heat set point to heating set point and return to no heat set point. _____

(2) Check blower fan air flow. _____ L/s (cfm)

(7) Check heating coil water flow. _____ L/s (gpm)

(8) Verify proper operation of heating water control valve. _____

(9) Check heating mode inlet air temperature. _____ degrees C
(degrees F)

(10) Check heating mode outlet air temperature. _____ degrees C
(degrees F)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

Contractor's Mechanical Representative

Contractor's Electrical Representative

Contractor's Testing, Adjusting and Balancing Representative

02022/DB-ME/SL
FY03 Whole Barracks Renewal, Fort Lewis, WA

Contractor's Controls Representative

Contracting Officer's Representative

Using Agency's Representative

Functional Performance Test Checklist - Unit Heaters

The Contracting Officer will select unit heaters to be spot-checked during the functional performance test. The number of terminals shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall demonstrate operation of selected unit heaters as per specifications including the following:

a. Verify unit heater response to room temperature set point adjustment. Changes to be heating set point to heating set point minus 10 degrees and return to heating set point. _____

b. Check blower fan speed. _____rpm

c. Check heating mode inlet air temperature. _____degrees C (degrees F)

d. Check heating mode outlet air temperature. _____degrees C(degrees F)

2. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative

Contractor's Mechanical Representative

Contractor's Electrical Representative

Contractor's Testing, Adjusting and Balancing Representative

Contractor's Controls Representative

Contracting Officer's Representative

Using Agency's Representative

Functional Performance Test Checklist - HVAC Controls

For HVAC System: For each HVAC control system

The Contracting Officer will select HVAC control systems to undergo functional performance testing. The number of systems shall not exceed 10 percent.

1. Functional Performance Test: Contractor shall verify operation of HVAC controls by performing the following tests:

a. Verify that controller is maintaining the set point by manually measuring the controlled variable with a thermometer, sling psychrometer, inclined manometer, etc.

b. Verify sensor/controller combination by manually measuring the controlled medium. Take readings from control panel display and compare readings taken manually. Record all readings.

Sensor _____
Manual measurement _____
Panel reading value _____

c. Verify system stability by changing the controller set point as follows:

- (1) Air temperature - 10 degrees
- (2) Water temperature - 10 degrees
- (3) Static pressure - 10 percent of set point
- (4) Relative humidity - 10 percent of set point

The control system shall be observed for 10 minutes after the change in set point. Instability or excessive hunting will be unacceptable.

d. Verify interlock with other HVAC controls.

e. Verify interlock with fire alarm control panel.

f. Verify interlock with EMCS.

g. Change controller set point 10 percent with EMCS and verify correct response.

2. Verify that operation of control system conforms to that specified in the sequence of operation.

3. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative _____

Contractor's Mechanical Representative	_____
Contractor's Electrical Representative	_____
Contractor's Testing, Adjusting and Balancing Representative	_____
Contractor's Controls Representative	_____
Contractor's Officer's Representative	_____
Using Agency's Representative	_____

Functional Performance Test Checklist - Energy Recovery System

For Energy Recovery System: [_____]

1. Functional Performance Test: Contractor shall demonstrate operation of energy recovery system as per specifications including the following: Start equipment to provide energy source for recovery system.

- a. Verify energy source is providing recoverable energy. _____
- b. Verify recovery system senses available energy and activates. _____
- c. Verify that recovery system deactivates when recoverable energy is no longer available. _____

2. Verify recovery system inlet/outlet readings, compare to design conditions and manufacturer's performance data.

	Design	Actual
Primary loop inlet temp degrees C(degrees F)	_____	_____
Primary loop outlet temp degrees C(degrees F)	_____	_____
Primary loop flow rate L/s (gpm)	_____	_____
Secondary loop inlet temp degrees C(degrees F)	_____	_____
Secondary loop outlet temp degrees C(degrees F)	_____	_____
Energy recovered kcal (BTU's)	_____	_____

3. Check and report unusual vibration, noise, etc.

4. Certification: We the undersigned have witnessed the above functional performance tests and certify that the item tested has met the performance requirements in this section of the specifications.

Signature and Date

Contractor's Chief Quality Control Representative_____

Contractor's Mechanical Representative _____

Contractor's Electrical Representative _____

Contractor's Testing , Adjusting and Balancing Representative _____

Contractor's Controls Representative _____

Contractor's Officer's Representative _____

Using Agency's Representative _____

END OF SECTION

SECTION 16070

SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM E 580 (1996) Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Moderate Seismic Restraint

CORPS OF ENGINEERS, HUNTSVILLE ENGINEERING AND SUPPORT CENTER (CEHNC)

TI 809-04 (1998) Seismic Design for Buildings

UNDERWRITERS LABORATORIES (UL)

UL 1570 (1995; Rev thru Feb 1999) Fluorescent Lighting Fixtures

UL 1571 (1995; Rev thru Feb 1999) Incandescent Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330
SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting Fixtures in Buildings; G
Equipment Requirements; -G

Detail drawings along with catalog cuts, templates, and erection and installation details, as appropriate, for the items listed. Submittals shall be complete in detail; shall indicate thickness, type, grade, class of metal, and dimensions; and shall show construction details, reinforcement, anchorage, and installation with relation to the building construction.

SD-03 Product Data

Lighting Fixtures in Buildings; G,
Equipment Requirements; G,

Copies of the design calculations with the detail drawings. Calculations shall be stamped by a registered engineer and shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

Contractor Designed Bracing; G,

Copies of the Design Calculations with the Drawings. Calculations shall be approved, certified, stamped and signed by a Registered Professional Engineer. Calculations shall verify the capability of structural members to which bracing is attached for carrying the load from the brace.

1.3 SYSTEM DESCRIPTION

1.3.1 General Requirements

The requirements for seismic protection measures described in this section shall be applied to the electrical equipment and systems listed below. Structural requirements shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

1.3.2 Electrical Equipment

Electrical equipment shall include the following items to the extent required on the drawings or in other sections of these specifications:

Control Panels	Air Handling Units
Pumps with Motors	Switch Boards
Light Fixtures	Transformers
Cable Trays	Communications Racks

1.3.3 Contractor Designed Bracing

The Contractor shall design the bracing in accordance with TI 809-04 and additional data furnished by the Contracting Officer. Resistance to lateral forces induced by earthquakes shall be accomplished without consideration of friction resulting from gravity loads. TI 809-04 uses parameters for the building, not for the equipment in the building; therefore, corresponding adjustments to the formulas shall be required. Loadings determined using TI 809-04 are based on strength design; therefore, the AISC LRFP specifications shall be used for the design. The bracing for the electrical equipment shall be developed by the Contractor.

1.3.4 Conduits Requiring No Special Seismic Restraints

Seismic restraints may be omitted from electrical conduit less than 64 mm trade size. All other interior conduit shall be seismically protected as specified.

1.4 EQUIPMENT REQUIREMENTS

1.4.1 Rigidly Mounted Equipment

The following specific items of equipment to be furnished under this contract shall be constructed and assembled to withstand the seismic forces specified in TI 809-04, Chapter 10. Each item of rigid electrical equipment shall be entirely located and rigidly attached on one side only of a building expansion joint. Piping, electrical conduit, etc., which cross the expansion joint shall be provided with flexible joints that are capable of accommodating displacements equal to the full width of the joint in both orthogonal directions.

Transformers
Switch Boards
Cable Trays
Communications Racks

1.4.2 Nonrigid or Flexibly-Mounted Equipment

Equipment shall be constructed and assembled to resist a horizontal lateral force of 1.33 times the operating weight of the equipment at the vertical center of gravity of the equipment.

PART 2 PRODUCTS

2.1 LIGHTING FIXTURE SUPPORTS

Lighting fixtures and supports shall conform to UL 1570 or UL 1571 as applicable.

2.2 SWAY BRACING MATERIALS

Sway bracing materials (e.g. rods, plates, rope, angles, etc.) shall be as specified in Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

PART 3 EXECUTION

3.1 SWAY BRACES FOR CONDUIT

Conduit shall be braced as for an equivalent weight pipe in accordance with Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

3.2 LIGHTING FIXTURES IN BUILDINGS

Lighting fixtures and supports shall conform to the following:

3.2.1 Pendant Fixtures

Pendant fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.2 Ceiling Attached Fixtures

3.2.2.1 Recessed Fluorescent Fixtures

Recessed fluorescent individual or continuous-row mounted fixtures shall be supported by a seismic-resistant suspended ceiling support system built in accordance with Section 09510 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10. Recessed lighting fixtures not over 25 kg (56 pounds) in weight may be supported by and attached directly to the ceiling system runners using screws or bolts, number and size as required by the seismic design. Fixture accessories, including louvers, diffusers, and lenses shall have lock or screw attachments.

3.2.2.2 Surface-Mounted Fluorescent Fixtures

Surface-mounted fluorescent individual or continuous-row fixtures shall be attached to a seismic-resistant ceiling support system built in accordance with Section 09510 ACOUSTICAL CEILINGS. Seismic protection for the fixtures shall conform to the requirements of TI 809-04, Chapter 10.

3.2.3 Assembly Mounted on Outlet Box

A supporting assembly, that is intended to be mounted on an outlet box, shall be designed to accommodate mounting features on 100 mm boxes, plaster rings, and fixture studs.

3.2.4 Wall-Mounted Emergency Light Unit

Attachments for wall-mounted emergency light units shall be designed and secured for the worst expected seismic disturbance at the site.

3.2.5 Lateral Force

Structural requirements for light fixture bracing shall be in accordance with Section 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT.

END OF SECTION

SECTION 16375

ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrument Transformers for Revenue Metering, 10 kV BIL through 350 kV BIL (0.6 kV NSV through 69 kV NSV)
ANSI C29.1	(1988; R 1996) Electrical Power Insulators - Test Methods
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C57.12.21	(1995) Requirements for Pad-Mounted, Compartmental-Type, Self-Cooled, Single-Phase Distribution Transformers with High-Voltage Bushings; (High-Voltage, 34 500 Grd Y/19 920 Volts and Below; Low-Voltage, 240/120; 167 kVA and Smaller)
ANSI C57.12.26	(1993) Pad-Mounted Compartmental-Type, Self-Cooled, Three-Phase Distribution Transformers for Use with Separable Insulated High-Voltage Connectors, High-Voltage, 34 500 Grd Y/19 920 Volts and Below; 2500 kVA and Smaller
ANSI C80.1	(1995) Rigid Steel Conduit - Zinc Coated
ANSI C119.1	(1986) Sealed Insulated Underground Connector Systems Rated 600 Volts

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1995) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM B 3	(1995) Soft or Annealed Copper Wire
ASTM B 8	(1993) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus

ASTM B 496	(1992) Compact Round Concentric-Lay-Stranded Copper Conductors
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM C 478M	(1997) Precast Reinforced Concrete Manhole Sections (Metric)
ASTM D 923	(1991) Sampling Electrical Insulating Liquids
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

ASSOCIATION OF EDISON ILLUMINATING COMPANIES (AEIC)

AEIC CS5	(1994) Cross-linked Polyethylene Insulated Shielded Power Cables Rated 5 Through 46 kV
AEIC CS6	(1996) Ethylene Propylene Rubber Insulated Shielded Power Cables Rated 5 Through 69 kV

FACTORY MUTUAL ENGINEERING AND RESEARCH (FM)

FM P7825a	(1998) Approval Guide Fire Protection
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE ANSI/IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contact Designations
IEEE ANSI/IEEE C37.90	(1989; R 1994) Relays and Relay Systems Associated with Electric Power Apparatus
IEEE ANSI/IEEE C37.90.1	(1989; R 1994) IEEE Standard Surge Withstand Capability (SWC) Tests for Protective Relays and Relay Systems
IEEE ANSI/IEEE C37.98	(1987; R 1990) Seismic Testing of Relays
IEEE ANSI/IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE ANSI/IEEE C57.13	(1993) Instrument Transformers
IEEE ANSI/IEEE C57.98	(1993) Guide for Transformer Impulse Tests
IEEE C62.1	(1989; R 1994) Surge Arresters for AC Power Circuits
IEEE C62.2	(1987; R 1994) Guide for the Application of Gapped Silicon-Carbide Surge Arresters for Alternating Current Systems

IEEE C62.11	(1993) IEEE Standard Metal-Oxide Surge Arresters for AC Power Circuits
IEEE Std 48	(1996) Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)
IEEE Std 100	(1996) IEEE Standard Dictionary of Electrical and Electronics Terms
IEEE Std 242	(1986; R 1991) Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 386	(1995) Separable Insulated Connector Systems for Power Distribution Systems Above 600V
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis
IEEE Std 404	(1993; errata) Cable Joints for Use with Extruded Dielectric Cable Rated 5000 V through 138 000 V and Cable Joints for Use with Laminated Dielectric Cable Rated 2500 V Through 500 000 V
IEEE Std 592	(1990; R 1996) Exposed Semiconducting Shields on Premolded High Voltage Cable Joints and Separable Insulated Connectors

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA FB 1	(1993) Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies
NEMA LA 1	(1992) Surge Arresters
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA WC 7	(1991; Rev 1) Cross-Linked-Thermosetting-Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
NEMA WC 8	(1991; Rev 1; Rev 2) Ethylene-Propylene-Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 467	(1993; Rev through Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486B	(1997; Rev Jun 1997) Wire Connectors for Use with Aluminum Conductors
UL 510	(1994; Rev through Nov 1997) Polyvinyl Chloride, Polyethylene and Rubber Insulating Tape
UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 651	(1995; Rev through Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 1072	(1995; Rev Mar 1998) Medium-Voltage Power Cable
UL 1242	(1996; Rev Apr 1997) Intermediate Metal Conduit

1.2 GENERAL REQUIREMENTS

1.2.1 Terminology

Terminology used in this specification is as defined in IEEE Std 100.

1.2.2 Service Conditions

Items provided under this section shall be specifically suitable for the following service conditions. Seismic details shall conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

- a. Fungus Control
- b. Altitude 100 m
- c. Frequency 60 Hz
- d. Seismic Zone 3

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Electrical Distribution System; G

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams manufacturers standard installation drawings and other information necessary to define the installation and enable the Government to check conformity with the requirements of the contract drawings.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures shall be included with the detail drawings. Approved departures shall be made at no additional cost to the Government.

Detail drawings shall show how components are assembled, function together and how they will be installed on the project. Data and drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall consist of the following:

- a. Detail drawings showing physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. All optional items shall be clearly identified as included or excluded.
- b. Internal wiring diagrams of equipment showing wiring as actually provided for this project. External wiring connections shall be clearly identified.

Detail drawings shall as a minimum depict the installation of the following items:

- a. Medium-voltage cables and accessories including cable installation plan.
- b. Transformers.
- c. Vault.
- d. Surge arresters.

Profile Drawings; G

The Contractor shall submit for review and approval profile drawings of the power and signal, duct and vault system shown on plans. The drawings shall show locations and elevations of structures relative to finished grade; provide for duct slope as specified in Paragraph: Duct Lines; and provide for minimum and maximum burial depth of vaults as indicated. The drawings shall be coordinated with other disciplines, and shall eliminate interferences with "existing" or "this contract" utilities. Drawings shall be stamped by a registered professional engineer. Drawings shall be included in the As-Built Drawings.

As-Built Drawings; G

The as-built drawings shall be a record of the construction as installed. The drawings shall include the information shown on the contract drawings as well as deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be a full sized set of prints marked to reflect deviations, modifications, and changes. The as-built

drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall provide three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within 10 calendar days from the time the drawings are returned to the Contractor.

SD-03 Product Data

Fault Current and Protective Devices Coordination Studies; G,

The study shall be submitted with protective device equipment submittals. No time extension or similar contract modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed shall be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Manufacturer's Catalog Data;

Catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists;

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each such item.

Installation Procedures;

As a minimum, installation procedures for transformers, substations, switchgear, and splices.

Procedures shall include cable pulling plans, diagrams, instructions, and precautions required to install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Factory Tests;

Certified factory test reports shall be submitted when the manufacturer performs routine factory tests, including tests required by standards listed in paragraph REFERENCES. Results of factory tests performed shall be certified by the manufacturer, or an approved testing laboratory, and submitted within 7 days following successful completion of the tests. The manufacturer's pass-fail criteria for tests specified in paragraph FIELD TESTING shall be included.

Field Testing;

A proposed field test plan, 30 days prior to testing the installed system. No field test shall be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Test Reports;

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The condition specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

Cable Installation Reports;

Six copies of the information described below in 215.9 by 279.4 mm (8-1/2 by 11 inch) binders having a minimum of three rings from which material may readily be removed and replaced, including a separate section for each cable pull. Sections shall be separated by heavy plastic dividers with tabs, with all data sheets signed and dated by the person supervising the pull.

- a. Site layout drawing with cable pulls numerically identified.
- b. A list of equipment used, with calibration certifications. The manufacturer and quantity of lubricant used on pull.
- c. The cable manufacturer and type of cable.
- d. The dates of cable pulls, time of day, and ambient temperature.
- e. The length of cable pull and calculated cable pulling tensions.
- f. The actual cable pulling tensions encountered during pull.

SD-07 Certificates

Materials and Equipment;

Where materials or equipment are specified to conform to the standards of the Underwriters Laboratories (UL) or to be constructed or tested, or both, in accordance with the standards of the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), or the National Electrical Manufacturers Association (NEMA),

the Contractor shall submit proof that the items provided conform to such requirements. The label of, or listing by, UL will be acceptable as evidence that the items conform. Either a certification or a published catalog specification data statement, to the effect that the item is in accordance with the referenced ANSI or IEEE standard, will be acceptable as evidence that the item conforms. A similar certification or published catalog specification data statement to the effect that the item is in accordance with the referenced NEMA standard, by a company listed as a member company of NEMA, will be acceptable as evidence that the item conforms. In lieu of such certification or published data, the Contractor may submit a certificate from a recognized testing agency equipped and competent to perform such services, stating that the items have been tested and that they conform to the requirements listed, including methods of testing of the specified agencies. Compliance with above-named requirements does not relieve the Contractor from compliance with any other requirements of the specifications.

Cable Splicer Qualification; G

A certification that contains the names and the qualifications of people recommended to perform the splicing and termination of medium-voltage cables approved for installation under this contract. The certification shall indicate that any person recommended to perform actual splicing and terminations has been adequately trained in the proper techniques and have had at least three recent years of experience in splicing and terminating the same or similar types of cables approved for installation. In addition, any person recommended by the Contractor may be required to perform a practice splice and termination, in the presence of the Contracting Officer, before being approved as a qualified installer of medium-voltage cables. If that additional requirement is imposed, the Contractor shall provide short sections of the approved types of cables along with the approved type of splice and termination kits, and detailed manufacturer's instruction for the proper splicing and termination of the approved cable types.

Cable Installer Qualifications;

The Contractor shall provide at least one onsite person in a supervisory position with a documentable level of competency and experience to supervise all cable pulling operations. A resume shall be provided showing the cable installers' experience in the last three years, including a list of references complete with points of contact, addresses and telephone numbers.

SD-10 Operation and Maintenance Data

Electrical Distribution System; G

Six copies of operation and maintenance manuals, within 7 calendar days following the completion of tests and including assembly, installation, operation and maintenance instructions, spare parts data which provides supplier name, current cost, catalog order number, and a recommended list of spare parts to be stocked. Manuals shall also include data outlining detailed procedures for system startup and operation, and a troubleshooting guide which lists possible operational problems and corrective action to be taken. A brief description of all equipment, basic operating features, and routine maintenance requirements shall also be included. Documents shall be bound in a binder marked or identified on the spine and front cover. A table of contents page shall be included and marked with pertinent contract information and contents of the manual. Tabs shall be provided to separate different types of documents, such as catalog ordering information, drawings, instructions, and spare parts data. Index sheets shall be provided for each section of the manual when warranted by the quantity of documents included under separate tabs or dividers.

Three additional copies of the instructions manual shall be provided within 30 calendar days following the manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected by the Contractor when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced. Oil filled transformers and switches shall be stored in accordance with the manufacturer's requirements. Metal poles shall be handled and stored in accordance with the manufacturer's instructions.

1.5 EXTRA MATERIALS

One additional spare fuse or fuse element for each furnished fuse or fuse element shall be delivered to the contracting officer when the electrical system is accepted. Two complete sets of all special tools required for maintenance shall be provided, complete with a suitable tool box. Special tools are those that only the manufacturer provides, for special purposes (to access compartments, or operate, adjust, or maintain special parts).

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 NAMEPLATES

2.2.1 General

Each major component of this specification shall have the manufacturer's name, address, type or style, model or serial number, and catalog number on a nameplate securely attached to the equipment. Nameplates shall be made of noncorrosive metal. Equipment containing liquid dielectrics shall have the type of dielectric on the nameplate. Sectionalizer switch nameplates shall have a schematic with all switch positions shown and labeled. As a minimum, nameplates shall be provided for transformers, circuit breakers, meters, switches, and switchgear.

2.2.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with nameplate information in accordance with IEEE ANSI/IEEE C57.12.00. Nameplates shall indicate the number of liters and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. If transformer nameplate is not so marked, the Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

2.3 CORROSION PROTECTION

2.3.1 Aluminum Materials

Aluminum shall not be used.

2.3.2 Ferrous Metal Materials

2.3.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

2.3.2.2 Equipment

Equipment and component items, including but not limited to transformer stations and ferrous metal luminaries not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall be in accordance with ASTM D 1654 with a rating of not less than 7 in accordance with TABLE 1, (procedure A). Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

2.3.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory shall be as specified in Section 09900 PAINTING, GENERAL.

2.4 CABLES

Cables shall be single conductor type unless otherwise indicated.

2.4.1 Medium-Voltage Cables

2.4.1.1 General

Cable construction shall be Type MV, conforming to NFPA 70 and UL 1072. Cables shall be manufactured for use in duct applications.

2.4.1.2 Ratings

Cables shall be rated for a circuit voltage of 15 kV.

2.4.1.3 Conductor Material

Underground cables shall be soft drawn copper complying with ASTM B 3 and ASTM B 8 for regular concentric and compressed stranding or ASTM B 496 for compact stranding.

2.4.1.4 Insulation

Cable insulation shall be ethylene-propylene-rubber (EPR) insulation conforming to the requirements of NEMA WC 8 and AEIC CS6. A 133 percent insulation level shall be used on 15 kV rated cables.

2.4.1.5 Shielding

Cables rated for 2 kV and above shall have a semiconducting conductor shield, a semiconducting insulation shield, and an overall copper tape shield for each phase. The shield tape shall be sized to meet IEEE C2 requirements for a ground fault availability of the following amperes.

Cable AWG/KCIL	Total Shield Area (CMIL)	30 Cycle Shield Fault Amps
2	7740	1335
4/0	10000	1720
500	12300	2122

2.4.1.6 Neutrals

Neutral conductors shall be copper employing the same insulation and jacket materials as phase conductors, except that a 600-volt insulation rating is acceptable.

2.4.1.7 Jackets

Cables shall be provided with a PVC jacket.

2.4.2 Low-Voltage Cables

Cables shall be rated 600 volts and shall conform to the requirements of NFPA 70, and must be UL listed for the application or meet the applicable section of either ICEA or NEMA standards.

2.4.2.1 Conductor Material

Underground cables shall be annealed copper complying with ASTM B 3 and ASTM B 8. Intermixing of copper and aluminum conductors is not permitted.

2.4.2.2 Insulation

Insulation must be in accordance with NFPA 70, and must be UL listed for the application or meet the applicable sections of either ICEA, or NEMA standards.

2.4.2.3 Jackets

Multiconductor cables shall have an overall PVC outer jacket.

2.4.2.4 In Duct

Cables shall be single-conductor cable, in accordance with NFPA 70.

2.5 CABLE JOINTS, TERMINATIONS, AND CONNECTORS

2.5.1 Medium-Voltage Cable Joints

Medium-voltage cable joints shall comply with IEEE Std 404 and IEEE Std 592. Medium-voltage cable terminations shall comply with IEEE Std 48. Joints shall be the standard products of a manufacturer and shall be either of the factory preformed type or of the kit type containing tapes and other required parts. Joints shall have ratings not less than the ratings of the cables on which they are installed. Splice kits may be of the heat-shrinkable type for voltages up to 15 kV, of the premolded splice and connector type, the conventional taped type, or the resin pressure-filled overcast taped type for voltages up to 35 kV; except that for voltages of 7.5 kV or less a resin pressure-filled type utilizing a plastic-tape mold is acceptable. Joints used in manholes, handholes, vaults and pull boxes shall be certified by the manufacturer for waterproof, submersible applications.

2.5.2 Medium-Voltage Separable Insulated Connectors

Separable insulated connectors shall comply with IEEE Std 386 and IEEE Std 592 and shall be of suitable construction or standard splice kits shall be used. Separable insulated connectors are acceptable for voltages up to 35 kV. Connectors shall be of the loadbreak type as indicated, of suitable construction for the application and the type of cable connected, and shall include cable shield adaptors. Separable insulated connectors shall not be used as substitutes for conventional permanent splices. External clamping points and test points shall be provided.

2.5.3 Low-Voltage Cable Splices

Low-voltage cable splices and terminations shall be rated at not less than 600 Volts. Splices in conductors No. 10 AWG and smaller shall be made with an insulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A. Splices in conductors No. 8 AWG and larger shall be made with noninsulated, solderless, pressure type connector, conforming to the applicable requirements of UL 486A and UL 486B. Splices shall then be covered with an insulation and jacket material equivalent to the conductor insulation and jacket. Splices below grade or in wet locations shall be sealed type conforming to ANSI C119.1 or shall be waterproofed by a sealant-filled, thick wall, heat shrinkable, thermosetting tubing or by pouring a thermosetting resin into a mold that surrounds the joined conductors.

2.5.4 Terminations

Terminations shall be in accordance with IEEE Std 48, Class 1 or Class 2; of the molded elastomer, wet-process porcelain, prestretched elastomer, heat-shrinkable elastomer, or taped type. Acceptable elastomers are track-resistant silicone rubber or track-resistant ethylene propylene compounds, such as ethylene propylene rubber or ethylene propylene diene monomer. Separable insulated connectors may be used for apparatus terminations, when such apparatus is provided with suitable bushings. Terminations shall be of the outdoor type, except that where installed inside outdoor equipment housings which are sealed against normal infiltration of moisture and outside air, indoor, Class 2 terminations are acceptable. Class 3 terminations are not acceptable. Terminations, where required, shall be provided with mounting brackets suitable for the intended installation and with grounding provisions for the cable shielding, metallic sheath, and armor.

2.5.4.1 Factory Preformed Type

Molded elastomer, wet-process porcelain, prestretched, and heat-shrinkable terminations shall utilize factory preformed components to the maximum extent practicable rather than tape build-up. Terminations shall have basic impulse levels as required for the system voltage level. Leakage distances shall comply with wet withstand voltage test requirements of IEEE Std 48 for the next higher Basic Insulation Level (BIL) level.

2.5.4.2 Taped Terminations

Taped terminations shall use standard termination kits providing terminal connectors, field-fabricated stress cones, and rain hoods. Terminations shall be at least 315mm long from the end of the tapered cable jacket to the start of the terminal connector, or not less than the kit manufacturer's recommendations, whichever is greater.

2.6 CONDUIT AND DUCTS

Duct lines shall be concrete-encased, thin-wall type for duct lines between manholes and for other medium-voltage lines. Low voltage lines run elsewhere may be direct-burial, thick-wall type.

2.6.1 Metallic Conduit

Intermediate metal conduit shall comply with UL 1242. Rigid galvanized steel conduit shall comply with UL 6 and ANSI C80.1. Metallic conduit fittings and outlets shall comply with UL 514A and NEMA FB 1.

2.6.2 Nonmetallic Ducts

2.6.2.1 Concrete Encased Ducts

UL 651 Schedule 40 or NEMA TC 6 Type EB.

2.6.2.2 Direct Burial

UL 651 Schedule 40, or NEMA TC 6 Type DB.

2.6.3 Conduit Sealing Compound

Compounds for sealing ducts and conduit shall have a putty-like consistency workable with the hands at temperatures as low as 2 degrees C (35 degrees F), shall neither slump at a temperature of 150 degrees C (300 degrees F), nor harden materially when exposed to the air. Compounds shall adhere to clean surfaces of fiber or plastic ducts; metallic conduits or conduit coatings; concrete, masonry, or lead; any cable sheaths, jackets, covers, or insulation materials; and the common metals. Compounds shall form a seal without dissolving, noticeably changing characteristics, or removing any of the ingredients. Compounds shall have no injurious effect upon the hands of workmen or upon materials.

2.7 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast-concrete manholes shall have the required strength established by ASTM C 478, ASTM C 478M. Frames and covers shall be made of gray cast iron and a machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be fabricated from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 69 MPa (10,000 psi) and a flexural strength of at least 34.5 MPa (5000 psi). Pullbox and handhole covers in sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers.

2.8 TRANSFORMERS, SUBSTATIONS, AND SWITCHGEAR

Transformers shall be of the outdoor type having the ratings and arrangements indicated. Medium-voltage ratings of cable terminations shall be 15 kV between phases for 133 percent insulation level.

2.8.1 Pad-Mounted Transformers

Pad-mounted transformers shall comply with ANSI C57.12.26 and shall be of the loop feed type. Pad-mounted transformer stations shall be assembled and coordinated by one manufacturer and each transformer station shall be shipped as a complete unit so that field installation requirements are limited to mounting each unit on a concrete pad and connecting it to primary and secondary lines. Stainless steel pins and hinges shall be provided. Barriers shall be provided between high- and low-voltage compartments. High-voltage compartment doors shall be interlocked with low-voltage compartment doors to prevent access to any high-voltage section unless its associated low-voltage section door has first been opened. Compartments shall be sized to meet the specific dimensional requirements of ANSI C57.12.26. Pentahead locking bolts shall be provided with provisions for a padlock.

2.8.1.1 High-Voltage Compartments

The high-voltage compartment shall be dead-front construction. Primary switching and protective devices shall include loadbreak switching, oil-immersed, current-limiting, bayonet-type fuses, medium-voltage separable loadbreak connectors, universal bushing wells and inserts or integral one piece bushings and surge arresters. Fuses shall comply with the requirements of paragraph METERING AND PROTECTIVE DEVICES. The switch shall be mounted inside transformer tank with switch operating handle located in high-voltage compartment and equipped with metal loop for hook stick operation. Fuses shall be interlocked with switches so that fuses can be removed only when the associated switch is in the "OPEN" position. Adjacent to medium-voltage cable connections, a nameplate or equivalent stenciled inscription shall be provided inscribed "DO NOT OPEN CABLE CONNECTORS UNLESS SWITCH IS OPEN." Surge arresters shall be fully insulated and configured to terminate on the same bushing as the primary cable by means of a loadbreak, feed-through bushing insert.

2.8.1.2 Load-Break Switch

Loop feed sectionalizer switches: Provide three, two-position, oil-immersed type switches to permit closed transition loop feed and sectionalizing. Each switch shall be rated at 15 kV, 95 kV BIL, with a continuous current rating and load-break rating of 200 amperes, and a make-and-latch rating of 10,000 rms amperes symmetrical. Locate the switch handle in the high-voltage compartment. Operation of switches shall be as follows:

ARRANGEMENT #	DESCRIPTION OF SWITCH ARRANGEMENT	SWITCH POSITION				XFMR SW	
		LINE A SW OPEN CLOSE		LINE B SW OPEN CLOSE		OPEN	CLOSE
1	Line A connected to Line B and both lines connected to transformer		X		X		X
2	Transformer connected to Line A only		X		X		X
3	Transformer connected to Line B only	X			X		X
4	Transformer open and loop closed		X		X	X	
5	Transformer open and loop open	X			X	X	

2.8.1.3 Transformer Tank Sections

Transformers shall comply with IEEE ANSI/IEEE C57.12.00, ANSI C57.12.21, and ANSI C57.12.26 and shall be of the mineral oil-insulated type. Transformers shall be suitable for outdoor use and shall have 2 separate windings per phase. Standard NEMA primary taps shall be provided. Where primary taps are not specified, 4, 2-1/2 percent rated kVA high-voltage taps shall be provided 2 above and 2 below rated, primary voltage. Operating handles for primary tap changers for de-energized operation

shall be located within high-voltage compartments, externally to transformer tanks. Adjacent to the tap changer operating handle, a nameplate or equivalent stenciled inscription shall be provided and inscribed "DO NOT OPERATE UNDER LOAD." Transformer ratings at 60 Hz shall be as follows:

Three-phase capacity..... kVA as indicated.

Impedance.....As indicated.

Temperature Rise.....65 degrees C.

High-voltage winding.....13800 volts.

High-voltage winding connections.....Delta.

Low-voltage winding.....as indicated

Low-voltage winding connections..... Wye

2.8.1.4 Low-Voltage Cable Compartments

Neutrals shall be provided with fully-insulated bushings. Clamp type cable terminations, suitable for copper conductors entering from below, shall be provided as necessary.

2.8.1.5 Accessories

High-voltage warning signs shall be permanently attached to each side of transformer stations. Voltage warning signs shall comply with IEEE C2. Copper-faced steel or stainless steel ground connection pads shall be provided in both the high- and low-voltage compartments. Dial-type thermometer, liquid-level gauge, and drain valve with built-in sampling device shall be provided for each transformer station. Insulated-bushing-type parking stands shall be provided adjacent to each separable load-break elbow to provide for cable isolation during sectionalizing operations.

2.8.2 Sectionalizers

Sectionalizing terminals shall consist of a junction for each phase with way(s) for separable connectors. Junctions shall be mounted inside vaults for above ground hookstick operation. Brackets and attachment hardware for mounting of junctions shall be stainless steel and include parking stands. Junctions shall be loadbreak in 200 ampere connection systems.

2.9 METERING AND PROTECTIVE DEVICES

2.9.1 Fuses, Medium-Voltage, Including Current-Limiting

2.9.1.1 Construction

Units shall be suitable for outdoor use. Fuses shall have integral blown-fuse indicators. All ratings shall be clearly visible.

2.9.1.2 Ratings

Current-limiting power fuses shall have ratings in accordance with ANSI C37.46 and as follows:

Nominal voltage.....13.8kV

Rated maximum voltage.....15kV

Rated continuous current.....200 A

BIL.....95kV

2.9.1.3 E-Rated, Current-Limiting Power Fuses

E-rated, current-limiting, power fuses shall conform to ANSI C37.46.

2.9.1.4 C-Rated, Current-Limiting Power Fuses

C-rated, current-limiting power fuses shall open in 1000 seconds at currents between 170 and 240 percent of the C rating.

2.9.2 Instrument Transformers

2.9.2.1 General

Instrument transformers shall comply with ANSI C12.11 and IEEE ANSI/IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.9.2.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall not be less than 1.0. Other thermal and mechanical ratings of current transformers and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accident open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.9.2.3 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of 0.3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.9.3 Protective Relaying

2.9.3.1 General

Solid-state protective relays shall be provided as shown and shall be of a type specifically designed for use on power switchgear or associated electric power apparatus. Protective relays shall conform to IEEE ANSI/IEEE C37.90. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.9.3.2 Construction

Relays shall be dustproof and moisture resistant. Necessary test devices shall be incorporated within each relay and shall provide a means for testing either from an external source of electric power or from associated instrument transformers. Each relay shall be provided with an operation indicator and

an external target reset device. Relays shall have necessary auxiliaries for proper operation. Relays and auxiliaries shall be suitable for operation with the instrument transformer ratios and connections provided.

2.9.3.3 Ratings

Relays shall be the manufacturer's standard items of equipment with appropriate ranges for time dial, tap, and other settings. Relay device numbers shall correspond to the function names and descriptions of IEEE ANSI/IEEE C37.2.

2.10 SURGE ARRESTERS

Surge arresters shall comply with NEMA LA 1, IEEE C62.1, IEEE C62.2, and IEEE C62.11 and shall be provided where indicated. Arresters shall be distribution class, rated as shown. Arresters for use at elevations in excess of 1.8 km (6000 feet) above mean sea level shall be specifically rated for that purpose. Arresters shall be equipped with mounting brackets suitable for the indicated installations. Arresters shall be of the metal-oxide varistor or combination valve-metal-oxide varistor type.

2.11 GROUNDING AND BONDING

2.11.1 Driven Ground Rods

Ground rods shall be copper-clad steel conforming to UL 467 not less than 19 mm (3/4 inch) in diameter by 3.1 m (10 feet) in length. Sectional type rods may be used.

2.11.2 Grounding Conductors

Grounding conductors shall be bare, except where installed in conduit with associated phase conductors. Insulated conductors shall be of the same material as phase conductors and green color-coded, except that conductors shall be rated no more than 600 volts. Bare conductors shall be ASTM B 8 soft-drawn unless otherwise indicated. Aluminum is not acceptable.

2.12 CONCRETE AND REINFORCEMENT

Concrete work shall have minimum 20 MPa (3000 psi) compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete reinforcing shall be as specified in Section 03200 CONCRETE REINFORCEMENT.

2.13 PADLOCKS

Padlocks shall comply with Section 08710 Door Hardware.

2.14 CABLE FIREPROOFING SYSTEMS

Cable fireproofing systems shall be listed in FM P7825a as a fire-protective coating or tape approved for grouped electrical conductors and shall be suitable for application on the type of medium-voltage cables provided. After being fully cured, materials shall be suitable for use where exposed to oil, water, gases, salt water, sewage, and fungus and shall not damage cable jackets or insulation. Asbestos materials are not acceptable.

2.14.1 Fireproof Coating

Cable fireproofing coatings shall be compounded of water-based thermoplastic resins, flame-retardant chemicals, and inorganic noncombustible fibers and shall be suitable for the application methods used. Coatings applied on bundled cables shall have a derating factor of less than 5 percent, and a dielectric strength of 95 volts per mil minimum after curing.

2.14.2 Fireproofing Tape

Fireproofing tape shall be at least 50 mm (2 inches) wide and shall be a flexible, conformable, polymeric, elastomer tape designed specifically for fireproofing cables.

2.14.3 Plastic Tape

Preapplication plastic tape shall be pressure sensitive, 0.254 mm (10 mil) thick, conforming to UL 510.

2.15 LIQUID DIELECTRICS

Liquid dielectrics for transformers, capacitors, reclosers, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral-oil or less-flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall not be used. Liquid dielectrics in retrofitted equipment shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 923 and have tests performed per ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

2.16 FACTORY TESTS

Factory tests shall be performed, as follows, in accordance with the applicable publications and with other requirements of these specifications. The Contracting Officer shall be notified at least 10 days before the equipment is ready for testing. The Contracting Officer reserves the right to witness the tests.

- a. Transformers: Manufacturer's standard routine tests in accordance with IEEE ANSI/IEEE C57.12.00.
- b. Transformers rated 200 kVA and above: Reduced full-wave, chopped-wave, and full-wave impulse test on each line and neutral terminal, in accordance with IEEE ANSI/IEEE C57.98.
- c. Protective Relays: Seismic tests in accordance with IEEE ANSI/IEEE C37.98. Surge withstand tests in accordance with IEEE ANSI/IEEE C37.90.1.
- d. Relaying Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.
- e. Instrument Current Transformers: Manufacturer's standard tests in accordance with IEEE ANSI/IEEE C57.13.
- f. Factory Preformed Terminations: Wet withstand voltage tests in accordance with IEEE Std 48 for the next higher BIL level.
- g. Electrical Power Insulators: Manufacturer's standard tests in accordance with ANSI C29.1.

2.17 FENCING

Fencing shall conform to the requirements of Section 02821 CHAIN LINK FENCE.

2.18 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for equipment ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.18.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.

2.18.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall utilize the fault current availability data obtained from the Directorate of Public Works for the fault current studies.

2.18.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Locations of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.18.4 Fault Current Analysis

2.18.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.18.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedances shall be those proposed. Data shall be documented in the report.

2.18.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. Provide a written narrative that describes: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and any relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost changes (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.18.6 Study Report

- a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.
- c. The report shall document existing power system data including time-current characteristic curves and protective device ratings and settings.
- d. The report shall contain fully coordinated composite time-current characteristic curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.
- e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Equipment and devices shall be installed and energized in accordance with the manufacturer's published instructions. Steel conduits installed underground shall be installed and protected from corrosion in conformance with the requirements of Section 16415 ELECTRICAL WORK, INTERIOR. Except as covered herein, excavation, trenching, and backfilling shall conform to the requirements of Section 02316 EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS. Concrete work shall conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE.

3.1.1 Conformance to Codes

The installation shall comply with the requirements and recommendations of NFPA 70 and IEEE C2 as applicable.

3.1.2 Verification of Dimensions

The Contractor shall become familiar with details of the work, shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.1.3 Disposal of Liquid Dielectrics

PCB-contaminated dielectrics must be marked as PCB and transported to and incinerated by an approved EPA waste disposal facility. The Contractor shall furnish certification of proper disposal. Contaminated dielectrics shall not be diluted to lower the contamination level.

3.2 CABLE AND BUSWAY INSTALLATION

The Contractor shall obtain from the manufacturer an installation manual or set of instructions which addresses such aspects as cable construction, insulation type, cable diameter, bending radius, cable temperature, lubricants, coefficient of friction, conduit cleaning, storage procedures, moisture seals, testing for and purging moisture, etc. The Contractor shall then perform pulling calculations and

prepare a pulling plan which shall be submitted along with the manufacturers instructions in accordance with SUBMITTALS.

3.2.1 Cable Installation Plan and Procedure

Cable shall be installed strictly in accordance with the cable manufacturer's recommendations. Each circuit shall be identified by means of a fiber, laminated plastic, or non-ferrous metal tags, or approved equal, in each manhole, handhole, junction box, and each terminal. Each tag shall contain the following information; cable type, conductor size, circuit number, circuit voltage, cable destination and phase identification.

3.2.1.1 Cable Inspection

The cable reel shall be inspected for correct storage positions, signs of physical damage, and broken end seals. If end seal is broken, moisture shall be removed from cable in accordance with the cable manufacturer's recommendations.

3.2.1.2 Duct Cleaning

Duct shall be cleaned with an assembly that consists of a flexible mandrel (manufacturers standard product in lengths recommended for the specific size and type of duct) that is 6.4 mm (1/4 inch) less than inside diameter of duct, 2 wire brushes, and a rag. The cleaning assembly shall be pulled through conduit a minimum of 2 times or until less than a volume of 131 cubic centimeters (8 cubic inches) of debris is expelled from the duct.

3.2.1.3 Duct Lubrication

The cable lubricant shall be compatible with the cable jacket for cable that is being installed. Application of lubricant shall be in accordance with lubricant manufacturer's recommendations.

3.2.1.4 Cable Installation

The Contractor shall provide a cable feeding truck and a cable pulling winch as required. The Contractor shall provide a pulling grip or pulling eye in accordance with cable manufacturer's recommendations. The pulling grip or pulling eye apparatus shall be attached to polypropylene or manila rope followed by lubricant front end packs and then by power cables. A dynamometer shall be used to monitor pulling tension. Pulling tension shall not exceed cable manufacturer's recommendations. The Contractor shall not allow cables to cross over while cables are being fed into duct. For cable installation in cold weather, cables shall be kept at 10 degrees C (50 degrees F) temperature for at least 24 hours before installation.

3.2.1.5 Cable Installation Plan

The Contractor shall submit a cable installation plan for all cable pulls in accordance with the detail drawings portion of paragraph SUBMITTALS. Cable installation plan shall include:

- a. Site layout drawing with cable pulls identified in numeric order of expected pulling sequence and direction of cable pull.
- b. List of cable installation equipment.
- c. Lubricant manufacturer's application instructions.
- d. Procedure for resealing cable ends to prevent moisture from entering cable.
- e. Cable pulling tension calculations of all cable pulls.

- f. Cable percentage conduit fill.
- g. Cable sidewall thrust pressure.
- h. Cable minimum bend radius and minimum diameter of pulling wheels used.
- i. Cable jam ratio.
- j. Maximum allowable pulling tension on each different type and size of conductor.
- k. Maximum allowable pulling tension on pulling device.

3.2.2 Duct Line

Cables shall be installed in duct lines where indicated. Cable splices in low-voltage cables shall be made in manholes and handholes only, except as otherwise noted. Cable joints in medium-voltage cables shall be made in manholes or approved pullboxes only. Neutral and grounding conductors shall be installed in the same duct with their associated phase conductors.

3.2.3 Electric Manholes

Cables shall be routed around the interior walls and securely supported from walls on cables racks. Cable routing shall minimize cable crossover, provide access space for maintenance and installation of additional cables, and maintain cable separation in accordance with IEEE C2.

3.3 CABLE JOINTS

Medium-voltage cable joints shall be made by qualified cable splicers only. Qualifications of cable splicers shall be submitted in accordance with paragraph SUBMITTALS. Shields shall be applied as required to continue the shielding system through each entire cable joint. Shields may be integrally molded parts of preformed joints. Shields shall be grounded at each joint or in accordance with manufacturer's recommended practice. Cable joints shall provide insulation and jacket equivalent to that of the associated cable. Armored cable joints shall be enclosed in compound-filled, cast-iron or alloy, splice boxes equipped with stuffing boxes and armor clamps of a suitable type and size for the cable being installed.

3.4 FIREPROOFING

Each medium-voltage cable and conductor in manholes shall be fire-proofed for their entire length within the manhole. Where cables and conductors have been lubricated to enhance pulling into ducts, the lubricant shall be removed from cables and conductors exposed in the manhole before fireproofing. Fire-stops shall be installed in each conduit entering or leaving a manhole.

3.4.1 Tape Method

Before application of fireproofing tape, plastic tape wrapping shall be applied over exposed metallic items such as the cable ground wire, metallic outer covering, or armor to minimize the possibility of corrosion from the fireproofing materials and moisture. Before applying fireproofing tape, irregularities of cables, such as at cable joints, shall be evened out with insulation putty. A flexible conformable polymeric elastomer fireproof tape shall be wrapped tightly around each cable spirally in 1/2 lapped wrapping or in 2 butt-jointed wrappings with the second wrapping covering the joints of the first.

3.4.2 Sprayable Method

Manholes shall be power ventilated until coatings are dry and dewatered and the coatings are cured. Ventilation requirements shall be in accordance with the manufacturer's instruction, but not less than 10 air changes per hour shall be provided. Cable coatings shall be applied by spray, brush, or glove to a wet film thickness that reduces to the dry film thickness approved for fireproofing by FM P7825a. Application methods and necessary safety precautions shall be in accordance with the manufacturers instructions. After application, cable coatings shall be dry to the touch in 1 to 2 hours and fully cured in 48 hours, except where the manufacturer has stated that because of unusual humidity or temperature, longer periods may be necessary.

3.5 DUCT LINES

3.5.1 Requirements

Numbers and sizes of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high-point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short-radius manufactured 90-degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inch) diameter, and 900 mm (36 inches) for ducts 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells whenever duct lines terminate in manholes or handholes.

3.5.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and match factory tapers. A coupling recommended by the duct manufacturer shall be used whenever an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.5.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70, except that electrical duct bank configurations for ducts 150 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. The separation between adjacent electric power and communication ducts shall conform to IEEE C2. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. The Contractor shall submit proposed bonding method for approval in accordance with the detail drawing portion of paragraph SUBMITTALS. At any point, except railroad and airfield crossings, tops of concrete encasements shall be not less than the cover requirements listed in NFPA 70. Where ducts are jacked under existing pavement, rigid steel conduit will be installed because of its strength. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not farther apart than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete and joints shall be staggered at least 150 mm vertically.

3.5.4 Nonencased Direct-Burial

Top of duct lines shall be below the frost line depth of 460 mm, but not less than 610 mm below finished grade and shall be installed with a minimum of 75 mm (3 inches) of earth around each duct,

except that between adjacent electric power and communication ducts, 300 mm of earth is required. Bottoms of trenches shall be graded toward manholes or handholes and shall be smooth and free of stones, soft spots, and sharp objects. Where bottoms of trenches comprise materials other than sand, a 75 mm layer of sand shall be laid first and compacted to approximate densities of surrounding firm soil before installing ducts. Joints in adjacent tiers of duct shall be vertically staggered at least 150mm. The first 150 mm layer of backfill cover shall be sand compacted as previously specified. The rest of the excavation shall be backfilled and compacted in 75 to 150 mm layers. Duct banks may be held in alignment with earth. However, high-tiered banks shall use a wooden frame or equivalent form to hold ducts in alignment prior to backfilling.

3.5.5 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendations for the particular type of duct and coupling selected and as approved.

3.5.5.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent cement on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4-turn twist to set the joint tightly.

3.5.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other ducts whose locations are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.6 MANHOLES, HANDHOLES, AND PULLBOXES

3.6.1 General

Manholes shall be constructed approximately where shown. The exact location of each manhole shall be determined after careful consideration has been given to the location of other utilities, grading, and paving. The location of each manhole shall be approved by the Contracting Officer before construction of the manhole is started. Manholes shall be the type noted on the drawings and shall be constructed in accordance with the applicable details as indicated. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic concrete construction. The Contractor may at his option utilize monolithically constructed precast-concrete manholes having the required strength and inside dimensions as required by the drawings or specifications. In paved areas, frames and covers for manhole and handhole entrances in vehicular traffic areas shall be flush with the finished surface of the paving. In unpaved areas, the top of manhole covers shall be approximately 15 mm above the finished grade. Where existing grades that are higher than finished grades are encountered, concrete assemblies designed for the purpose shall be installed to elevate temporarily the manhole cover to existing grade level. All duct lines entering manholes must be installed on compact soil or otherwise supported when entering a manhole to prevent shear stress on the duct at the point of entrance to the manhole. Duct lines entering cast-in-place concrete manholes shall be cast in-place with the manhole. Duct lines entering precast concrete manholes through a precast knockout penetration shall be grouted tight with a portland cement mortar. PVC duct lines entering precast manholes through a PVC endbell shall be solvent welded to the endbell. A cast metal grille-type sump frame and cover shall be installed over the manhole sump. A cable-pulling iron shall be installed in the wall opposite each duct line entrance.

3.6.2 Electric Manholes

Cables shall be securely supported from walls by hot-dip galvanized cable racks with a plastic coating over the galvanizing and equipped with adjustable hooks and insulators. The number of cable racks indicated shall be installed in each manhole and not less than 2 spare hooks shall be installed on each cable rack. Insulators shall be made of high-glazed porcelain. Insulators will not be required on spare hooks.

3.6.3 Communications Manholes

The number of hot-dip galvanized cable racks with a plastic coating over the galvanizing indicated shall be installed in each telephone manhole. Each cable rack shall be provided with 2 cable hooks.

3.6.4 Handholes

Handholes shall be located approximately as shown. Handholes shall be of the type noted on the drawings and shall be constructed in accordance with the details shown.

3.6.5 Pullboxes

Pullbox tops shall be flush with sidewalks or curbs or placed 15 mm above surrounding grades when remote from curbed roadways or sidewalks. Covers shall be marked "Low-Voltage" and provided with 2 lifting eyes and 2 hold-down bolts. Each box shall have a suitable opening for a ground rod. Conduit, cable, ground rod entrances, and unused openings shall be sealed with mortar.

3.6.6 Ground Rods

A ground rod shall be installed at the manholes, handholes and pullboxes. Ground rods shall be driven into the earth before the manhole floor is poured so that approximately 100 mm of the ground rod will extend above the manhole floor. When precast concrete manholes are used, the top of the ground rod may be below the manhole floor and a No. 1/0 AWG ground conductor brought into the manhole through a watertight sleeve in the manhole wall.

3.7 PAD-MOUNTED EQUIPMENT INSTALLATION

Pad-mounted equipment shall be installed on concrete pads in accordance with the manufacturer's published, standard installation drawings and procedures, except that they shall be modified to meet the requirements of this document. Units shall be installed so that they do not damage equipment or scratch painted or coated surfaces. After installation, surfaces shall be inspected and scratches touched up with a paint or coating provided by the manufacturer especially for this purpose. Three-phase transformers shall be installed with A-B-C, clockwise phase sequence. Primary taps shall be set at mid point.

3.7.1 Concrete Pads

3.7.1.1 Construction

Concrete pads for pad-mounted electrical equipment may be either pre-fabricated or poured-in-place. Pads shall be constructed as indicated, except that exact pad dimensions and mounting details are equipment specific and are the responsibility of the Contractor. Tops of concrete pads shall be level and shall project 100 mm above finished paving or grade and sloped to drain. Edges of concrete pads shall have 20 mm chamfer. Conduits for primary, secondary, and grounding conductors shall be set in place prior to placement of concrete pads. Where grounding electrode conductors are installed through concrete pads, PVC conduit sleeves shall be installed through the concrete to provide physical protection. To facilitate cable installation and termination, the concrete pad shall be provided with a rectangular hole below the primary and secondary compartments, sized in accordance with the

manufacturer's recommended dimensions. Upon completion of equipment installation the rectangular hole shall be filled with masonry grout.

3.7.1.2 Concrete and Reinforcement

Concrete work shall have minimum 20 MPa (3000 psi) compressive strength and conform to the requirements of Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete pad reinforcement shall be in accordance with Section 03200 CONCRETE REINFORCEMENT.

3.7.1.3 Sealing

When the installation is complete, the Contractor shall seal all conduit and other entries into the equipment enclosure with an approved sealing compound. Seals shall be of sufficient strength and durability to protect all energized live parts of the equipment from rodents, insects, or other foreign matter.

3.7.2 Padlocks

Padlocks shall be provided for pad-mounted equipment. Padlocks shall be keyed as directed by the Contracting Officer.

3.8 CONNECTIONS BETWEEN AERIAL AND UNDERGROUND SYSTEMS

Connections between aerial and underground systems shall be made as shown. Underground cables shall be extended up poles in conduit to cable terminations. Conduits shall be secured to the poles by 2-hole galvanized steel pipe straps spaced not more than 3 m (10 feet) apart and with 1 strap not more than 300 mm (12 inches) from any bend or termination. Conduits shall be equipped with bushings to protect cables and minimize water entry. Cables shall be supported by devices separate from the conduit, near their point of exit from the conduit or guard.

3.9 CONNECTIONS TO BUILDINGS

Cables shall be extended into the various buildings as indicated, and shall be connected to the first applicable termination point in each building. Interfacing with building interior conduit systems shall be at conduit stubouts terminating 1.5 m outside of a building and 600 mm below finished grade as specified and provided under Section 16415 ELECTRICAL WORK, INTERIOR. After installation of cables, conduits shall be sealed with caulking compound to prevent entrance of moisture or gases into buildings.

3.10 GROUNDING

A ground ring consisting of the indicated configuration of bare copper conductors and driven ground rods shall be installed around pad-mounted equipment as shown. Equipment frames of metal-enclosed equipment, and other noncurrent-carrying metal parts, such as cable shields, cable sheaths and armor, and metallic conduit shall be grounded. At least 4 connections shall be provided from a transformer, to the ground ring. Metallic frames and covers of handholes and pull boxes shall be grounded by use of a braided, copper ground strap with equivalent ampacity of No. 6 AWG.

3.10.1 Grounding Electrodes

Grounding electrodes shall be installed as shown on the drawings and as follows:

- a. Driven rod electrodes - Unless otherwise indicated, ground rods shall be driven into the earth until the tops of the rods are approximately 300 mm below finished grade.

- b. Ground ring - A ground ring shall be installed as shown consisting of bare copper conductors installed as shown. Ground ring conductors shall be sized as shown.
- c. Additional electrodes - When the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors to achieve the specified ground resistance. The additional electrodes will be up to three, 3 m (10 feet) rods spaced a minimum of 3 m.

3.10.2 Grounding and Bonding Connections

Connections above grade shall be made by the fusion-welding process or with bolted solderless connectors, in compliance with UL 467, and those below grade shall be made by a fusion-welding process. Where grounding conductors are connected to aluminum-composition conductors, specially treated or lined copper-to-aluminum connectors suitable for this purpose shall be used.

3.10.3 Grounding and Bonding Conductors

Grounding and bonding conductors include conductors used to bond transformer enclosures and equipment frames to the grounding electrode system. Grounding and bonding conductors shall be sized as shown, and located to provide maximum physical protection. Bends greater than 45 degrees in ground conductors are not permitted. Routing of ground conductors through concrete shall be avoided. When concrete penetration is necessary, nonmetallic conduit shall be cast flush with the points of concrete entrance and exit so as to provide an opening for the ground conductor, and the opening shall be sealed with a suitable compound after installation.

3.10.4 Surge Arrester Grounding

Surge arresters and neutrals shall be bonded directly to the transformer enclosure and then to the grounding electrode system with a bare copper conductor, sized as shown. Lead lengths shall be kept as short as practicable with no kinks or sharp bends.

3.10.5 Manhole, Handhole, or Concrete Pullbox Grounding

Ground rods installed in manholes, handholes, or concrete pullboxes shall be connected to cable racks, cable-pulling irons, the cable shielding, metallic sheath, and armor at each cable joint or splice by means of a No. 4 AWG braided tinned copper wire. Connections to metallic cable sheaths shall be by means of tinned terminals soldered to ground wires and to cable sheaths. Care shall be taken in soldering not to damage metallic cable sheaths or shields. Ground rods shall be protected with a double wrapping of pressure-sensitive plastic tape for a distance of 50 mm above and 150 mm below concrete penetrations. Grounding electrode conductors shall be neatly and firmly attached to manhole or handhole walls and the amount of exposed bare wire shall be held to a minimum.

3.10.6 Metal Splice Case Grounding

Metal splice cases for medium-voltage direct-burial cable shall be grounded by connection to a driven ground rod located within 600 mm of each splice box using a grounding electrode conductor having a current-carrying capacity of at least 20 percent of the individual phase conductors in the associated splice box, but not less than No. 6 AWG.

3.10.7 Riser Pole Grounding

A single continuous vertical grounding electrode conductor shall be installed on each riser pole and connected directly to the grounding electrodes indicated on the drawings or required by these specifications. All equipment, neutrals, surge arresters, and items required to be grounded shall be connected directly to this vertical conductor. The grounding electrode conductor shall be sized as

shown. Grounding electrode conductors shall be stapled to wood poles at intervals not exceeding 600 mm.

3.11 FIELD TESTING

3.11.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 10 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. Field test reports shall be signed and dated by the Contractor.

3.11.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.11.3 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.
- b. Ground ring - 25 ohms.

3.11.4 Medium-Voltage Cable Test

After installation and before the operating test or connection to an existing system, the medium-voltage cable system shall be given a high potential test. Direct-current voltage shall be applied on each phase conductor of the system by connecting conductors as one terminal and connecting grounds or metallic shieldings or sheaths of the cable as the other terminal for each test. Prior to making the test, the cables shall be isolated by opening applicable protective devices and disconnecting equipment. The test shall be conducted with all splices, connectors, and terminations in place. The method, voltage, length of time, and other characteristics of the test for initial installation shall be in accordance with NEMA WC 7 or NEMA WC 8 for the particular type of cable installed, except that 28 kV and 35 kV insulation test voltages shall be in accordance with either AEIC CS5 or AEIC CS6 as applicable, and shall not exceed the recommendations of IEEE Std 404 for cable joints and IEEE Std 48 for cable terminations unless the cable and accessory manufacturers indicate higher voltages are acceptable for testing. Should any cable fail due to a weakness of conductor insulation or due to defects or injuries incidental to the installation or because of improper installation of cable, cable joints, terminations, or other connections, the Contractor shall make necessary repairs or replace cables as directed. Repaired or replaced cables shall be retested.

3.11.5 Low-Voltage Cable Test

Low-voltage cable, complete with splices, shall be tested for insulation resistance after the cables are installed, in their final configuration, ready for connection to the equipment, and prior to energization. The test voltage shall be 500 volts dc, applied for one minute between each conductor and ground and between all possible combinations conductors in the same trench, duct, or cable, with all other conductors in the same trench, duct, or conduit. The minimum value of insulation shall be:

$$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304,800 / (\text{length of cable in meters})$$

Each cable failing this test shall be repaired or replaced. The repaired cable shall be retested until failures have been eliminated.

3.11.6 Liquid-Filled Transformer Tests

The following field tests shall be performed on all liquid-filled transformers. Pass-fail criteria shall be in accordance with transformer manufacturer's specifications.

- a. Insulation resistance test phase-to-ground.
- b. Turns ratio test.
- c. Correct phase sequence.
- d. Correct operation of tap changer.

3.11.7 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers. Pass-fail criteria shall be in accordance with the circuit breaker manufacturer's specifications.

- a. Insulation resistance test phase-to-phase.
- b. Insulation resistance test phase-to-ground.
- c. Closed breaker contact resistance test.
- d. Power factor test.
- e. High-potential test.
- f. Manual and electrical operation of the breaker.

3.11.8 Protective Relays

Protective relays shall be visually and mechanically inspected, adjusted, tested, and calibrated in accordance with the manufacturer's published instructions. Tests shall include pick-up, timing, contact action, restraint, and other aspects necessary to ensure proper calibration and operation. Relay settings shall be implemented in accordance with the coordination study. Relay contacts shall be manually or electrically operated to verify that the proper breakers and alarms initiate. Relaying current transformers shall be field tested in accordance with IEEE ANSI/IEEE C57.13.

3.11.9 Pre-Energization Services

Calibration, testing, adjustment, and placing into service of the installation shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of 2

years of current product experience. The following services shall be performed on the equipment listed below. These services shall be performed subsequent to testing but prior to the initial energization. The equipment shall be inspected to ensure that installation is in compliance with the recommendations of the manufacturer and as shown on the detail drawings. Terminations of conductors at major equipment shall be inspected to ensure the adequacy of connections. Bare and insulated conductors between such terminations shall be inspected to detect possible damage during installation. If factory tests were not performed on completed assemblies, tests shall be performed after the installation of completed assemblies. Components shall be inspected for damage caused during installation or shipment to ensure packaging materials have been removed. Components capable of being both manually and electrically operated shall be operated manually prior to the first electrical operation. Components capable of being calibrated, adjusted, and tested shall be calibrated, adjusted, and tested in accordance with the instructions of the equipment manufacturer. Items for which such services shall be provided, but are not limited to, are the following:

- a. Pad-mounted transformers

3.11.10 Operating Tests

After the installation is completed, and at such times as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the requirements herein. An operating test report shall be submitted in accordance with paragraph SUBMITTALS.

3.12 MANUFACTURER'S FIELD SERVICE

3.12.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, and servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training session shall be submitted.

3.12.2 Installation Engineer

After delivery of the equipment, the Contractor shall furnish one or more field engineers, regularly employed by the equipment manufacturer to supervise the installation of the equipment, assist in the performance of the onsite tests, initial operation, and instruct personnel as to the operational and maintenance features of the equipment.

3.13 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

END OF SECTION

SECTION 16415
ELECTRICAL WORK, INTERIOR

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C39.1	(1981; R 1992) Requirements for Electrical Analog Indicating Instruments
ANSI C78.1	(1991; C78.1a; R 1996) Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
ANSI C78.20	(1995) Electric Lamps - Characteristics of Incandescent Lamps A, G, PS, and Similar Shapes with E26 Medium Screw Bases
ANSI C78.21	(1995) Physical and Electrical Characteristics - Incandescent Lamps - PAR and R Shapes
ANSI C78.1350	(1990) 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1351	(1989) 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1352	(1990) 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps
ANSI C78.1355	(1989) 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps
ANSI C78.1375	(1996) 400-Watt, M59 Single-Ended Metal-Halide lamps
ANSI C78.1376	(1996) 1000-Watt, M47 Single-Ended Metal-Halide Lamps
ANSI C78.2A	(1991) 18 & 26- Watt, Compact Fluorescent Quad Tube Lamps
ANSI C78.2B	(1992) 9 & 13-Watt, Compact Fluorescent Quad Tube Lamps
ANSI C82.1	(1997) Specifications for Fluorescent Lamp Ballasts
ANSI C82.4	(1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM B 1	(1995) Hard-Drawn Copper Wire
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ASTM B 8	(1999) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM D 709	(1992; R 1997) Laminated Thermosetting Materials
ASTM D 4059	(1996) Analysis of Polychlorinated Biphenyls in Insulating Liquids by Gas Chromatography

CODE OF FEDERAL REGULATIONS (CFR)

47 CFR 18	Industrial, Scientific, and Medical Equipment
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit-Breaker Switchgear
IEEE C57.12.00	(1993) IEEE Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.13	(1993) Instrument Transformers
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems Enclosures
NEMA LE 4	(1987) Recessed Luminaires, Ceiling Compatibility
NEMA MG 1	(1993; Rev 1; Rev 2; Rev 3; Rev 4) Motors and Generators

NEMA MG 10	(1994) Energy Management Guide for Selection and Use of Polyphase Motors
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA PB 1	(1995) Panelboards
NEMA PB 2	(1995) Deadfront Distribution Switchboards
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA ST 20	(1992) Dry-Type Transformers for General Applications
NEMA TC 2	(1990) Electrical Polyvinyl Chloride (PVC) Tubing (EPT) and Conduit (EPC-40 and EPC-80)
NEMA VE 1	(1996) Metal Cable Tray Systems
NEMA WD 1	(1983; R 1989) General Requirements for Wiring Devices
NEMA WD 6	(1988) Wiring Devices - Dimensional Requirements

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
NFPA 101	(1997; Errata 97-1; TIA 97-1) Life Safety Code

UNDERWRITERS LABORATORIES (UL)

UL 1	(1993; Rev through Jan 1995) Flexible Metal Conduit
UL 5	(1996) Surface Metal Raceways and Fittings
UL 6	(1997) Rigid Metal Conduit
UL 20	(1995; Rev through Oct 1998) General-Use Snap Switches
UL 50	(1995; Rev through Oct 1997) Enclosures for Electrical Equipment
UL 67	(1993; Rev through Nov 1995) Panelboards
UL 83	(1998) Thermoplastic-Insulated Wires and Cables
UL 98	(1994; R through Jun 1998) Enclosed and Dead-Front Switches
UL 198B	(1995) Class H Fuses

UL 198C	(1986; Rev through Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198G	(1988; Rev May 1988) Fuses for Supplementary Overcurrent Protection
UL 198H	(1988; Rev through Nov 1993) Class T Fuses
UL 198L	(1995; Rev May 1995) D-C Fuses for Industrial Use
UL 360	(1996; Rev through Oct 1997) Liquid-Tight Flexible Steel Conduit
UL 467	(1993; Rev through Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev through Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 486C	(1997; Rev through Aug 1998) Splicing Wire Connectors
UL 486E	(1994; Rev through Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
UL 489	(1996; Rev through Dec 1998) Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures
UL 498	(1996; Rev through Sep 1998) Attachment Plugs and Receptacles
UL 506	(1994; Rev Oct 1997) Specialty Transformers
UL 508	(1999) Industrial Control Equipment
UL 510	(1994; Rev through Apr 1998) Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape
UL 512	(1993; R Dec 1995) Fuseholders
UL 514A	(1996; Rev Jul 1998) Metallic Outlet Boxes
UL 514B	(1997; Rev Oct 1998) Fittings for Cable and Conduit
UL 514C	(1996; R Sep 1998) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers
UL 542	(1994; Rev through Jul 1998) Lampholders, Starters, and Starter Holders for Fluorescent Lamps
UL 651	(1995; Rev through Oct 1998) Schedule 40 and 80 Rigid PVC Conduit

UL 651A	(1995; Rev through Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 797	(1993; Rev through Mar 1997) Electrical Metallic Tubing
UL 817	(1994; Rev through Jul 1998) Cord Sets and Power-Supply Cords
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 869A	(1998) Reference Standard for Service Equipment
UL 891	(1994; Rev through Jan 1995) Dead-Front Switchboards
UL 916	(1998) Energy Management Equipment
UL 924	(1995; Rev through Oct 97) Emergency Lighting and Power Equipment
UL 943	(1993; Rev through May 1998) Ground-Fault Circuit-Interrupters
UL 1004	(1994; Rev through Dec 1997) Electric Motors
UL 1022	(1998) Line Isolation Monitors
UL 1029	(1994; Rev through Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1047	(1995; Rev Jul 1998) Isolated Power Systems Equipment
UL 1242	(1996; Rev Mar 1998) Intermediate Metal Conduit
UL 1449	(1996; Rev through Oct 1998) Transient Voltage Surge Suppressors
UL 1564	(1993; Rev Sep 1998) Industrial Battery Chargers
UL 1570	(1995; Rev through Jun 1997) Fluorescent Lighting Fixtures
UL 1571	(1995; Rev through Jun 1997) Incandescent Lighting Fixtures
UL 1572	(1995; Rev through Jun 1997) High Intensity Discharge Lighting Fixtures
UL 1660	(1994; Rev Apr 1998) Liquid-Tight Flexible Nonmetallic Conduit
UL Elec Const Dir	(1998) Electrical Construction Equipment Directory

1.2 GENERAL

1.2.1 Rules

The installation shall conform to the requirements of NFPA 70 and NFPA 101, unless more stringent requirements are indicated or shown.

1.2.2 Coordination

The drawings indicate the extent and the general location and arrangement of equipment, conduit, and wiring. The Contractor shall become familiar with all details of the work and verify all dimensions in the field so that the outlets and equipment shall be properly located and readily accessible. Lighting fixtures, outlets, and other equipment and materials shall be carefully coordinated with mechanical or structural features prior to installation and positioned according to architectural reflected ceiling plans; otherwise, lighting fixtures shall be symmetrically located according to the room arrangement when uniform illumination is required, or asymmetrically located to suit conditions fixed by design and shown. Raceways, junction and outlet boxes, and lighting fixtures shall not be supported from sheet metal roof decks. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change. The Contractor shall coordinate the electrical requirements of the mechanical work and provide all power related circuits, wiring, hardware and structural support, even if not shown on the drawings.

1.2.3 Special Environments

1.2.3.1 Weatherproof Locations

Wiring, fixtures, and equipment in designated locations shall conform to NFPA 70 requirements for installation in damp or wet locations.

1.2.3.2 Ducts, Plenums and Other Air-Handling Spaces

Wiring and equipment in ducts, plenums and other air-handling spaces shall be installed using materials and methods in conformance with NFPA 70 unless more stringent requirements are indicated in this specification or on the contract drawings.

1.2.4 Standard Products

Material and equipment shall be a standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

1.2.5 Nameplates

1.2.5.1 Identification Nameplates

Major items of electrical equipment and major components shall be permanently marked with an identification name to identify the equipment by type or function and specific unit number as indicated. Designation of motors shall coincide with their designation in the motor control center or panel. Unless otherwise specified, identification nameplates shall be made of laminated plastic in accordance with ASTM D 709 with black outer layers and a white core. Edges shall be chamfered. Plates shall be fastened with black-finished round-head drive screws, except motors, or approved nonadhesive metal fasteners. When the nameplate is to be installed on an irregular-shaped object, the Contractor shall devise an approved support suitable for the application and ensure the proper installation of the supports and nameplates. In all instances, the nameplate shall be installed in a conspicuous location. At the option of the Contractor, the equipment manufacturer's standard embossed nameplate material with black paint-filled letters may be furnished in lieu of laminated plastic. The front of each

panelboard, motor control center, switchgear, and switchboard shall have a nameplate to indicate the phase letter, corresponding color and arrangement of the phase conductors. The following equipment, as a minimum, shall be provided with identification nameplates:

Minimum 6.4 mm High Letters	Minimum 3.2 mm High Letters
Panelboards	Control Power Transformers
Starters	Control Devices
Safety Switches	Instrument Transformers
Transformers	
Equipment Enclosures	
Switchgear	
Motors	

Each panel, section, or unit in motor control centers, switchgear or similar assemblies shall be provided with a nameplate in addition to nameplates listed above, which shall be provided for individual compartments in the respective assembly, including nameplates which identify "future," "spare," and "dedicated" or "equipped spaces."

1.2.5.2 Liquid-Filled Transformer Nameplates

Power transformers shall be provided with Nameplate C information in accordance with IEEE C57.12.00. Nameplates shall indicate percent impedance, voltage, kVA, frequency, number of phases, cooling class, insulation class, temperature rise, the number of gallons and composition of liquid-dielectric, and shall be permanently marked with a statement that the transformer dielectric to be supplied is non-polychlorinated biphenyl. The Contractor shall furnish manufacturer's certification for each transformer that the dielectric is non-PCB classified, with less than 2 ppm PCB content in accordance with paragraph LIQUID DIELECTRICS. Certifications shall be related to serial numbers on transformer nameplates. Transformer dielectric exceeding the 2 ppm PCB content or transformers without certification will be considered as PCB insulated and will not be accepted.

1.2.6 As-Built Drawings

Following the project completion or turnover, within 30 days the Contractor shall furnish 2 sets of as-built drawings to the Contracting Officer.

1.2.7 Recessed Light Fixtures (RLF) Option

The Contractor has the option to substitute inch-pound (I-P) RLF to metric RLF. This option shall be coordinated with Section 09510 ACOUSTICAL CEILINGS.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330

SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Interior Electrical Equipment; G.

Detail drawings consisting of equipment drawings, illustrations, schedules, instructions, diagrams, and other information necessary to define the installation. Detail drawings shall show the rating of items and systems and how the components of an item and system are assembled, function together, and how they will be installed on the project. Data and

drawings for component parts of an item or system shall be coordinated and submitted as a unit. Data and drawings shall be coordinated and included in a single submission. Multiple submissions for the same equipment or system are not acceptable except where prior approval has been obtained from the Contracting Officer. In such cases, a list of data to be submitted later shall be included with the first submission. Detail drawings shall show physical arrangement, construction details, connections, finishes, materials used in fabrication, provisions for conduit or busway entrance, access requirements for installation and maintenance, physical size, electrical characteristics, foundation and support details, and equipment weight. Drawings shall be drawn to scale and/or dimensioned. Optional items shall be clearly identified as included or excluded. Detail drawings shall as a minimum include:

- a. Transformers.
- b. Switchgear.
- c. Single line electrical diagrams including primary, metering, sensing and relaying, control wiring, and control logic.
- d. Sway bracing for suspended luminaires.

Structural drawings showing the structural or physical features of major equipment items, components, assemblies, and structures, including foundations or other types of supports for equipment and conductors. These drawings shall include accurately scaled or dimensioned outline and arrangement or layout drawings to show the physical size of equipment and components and the relative arrangement and physical connection of related components. Weights of equipment, components and assemblies shall be provided when required to verify the adequacy of design and proposed construction of foundations or other types of supports. Dynamic forces shall be stated for switching devices when such forces must be considered in the design of support structures. The appropriate detail drawings shall show the provisions for leveling, anchoring, and connecting all items during installation, and shall include any recommendations made by the manufacturer.

Electrical drawings including single-line and three-line diagrams, and schematics or elementary diagrams of each electrical system; internal wiring and field connection diagrams of each electrical device when published by the manufacturer; wiring diagrams of cabinets, panels, units, or separate mountings; interconnection diagrams that show the wiring between separate components of assemblies; field connection diagrams that show the termination of wiring routed between separate items of equipment; internal wiring diagrams of equipment showing wiring as actually provided for this project. Field wiring connections shall be clearly identified.

If departures from the contract drawings are deemed necessary by the Contractor, complete details of such departures, including changes in related portions of the project and the reasons why, shall be submitted with the detail drawings. Approved departures shall be made at no additional cost to the Government.

SD-03 Product Data

Manufacturer's Catalog;

Data composed of catalog cuts, brochures, circulars, specifications, product data, and printed information in sufficient detail and scope to verify compliance with the requirements of the contract documents.

Material, Equipment, and Fixture Lists;

A complete itemized listing of equipment and materials proposed for incorporation into the work. Each entry shall include an item number, the quantity of items proposed, and the name of the manufacturer of each item.

Installation Procedures;

Installation procedures for rotating equipment, transformers, switchgear, battery systems, voltage regulators, and grounding resistors. Procedures shall include diagrams, instructions, and precautions required to install, adjust, calibrate, and test devices and equipment.

As-Built Drawings; G.

The as-built drawings shall be a record of the construction as installed. The drawings shall include all the information shown on the contract drawings, deviations, modifications, and changes from the contract drawings, however minor. The as-built drawings shall be kept at the job site and updated daily. The as-built drawings shall be a full-sized set of prints marked to reflect all deviations, changes, and modifications. The as-built drawings shall be complete and show the location, size, dimensions, part identification, and other information. Additional sheets may be added. The as-built drawings shall be jointly inspected for accuracy and completeness by the Contractor's quality control representative and by the Contracting Officer prior to the submission of each monthly pay estimate. Upon completion of the work, the Contractor shall submit three full sized sets of the marked prints to the Contracting Officer for approval. If upon review, the as-built drawings are found to contain errors and/or omissions, they will be returned to the Contractor for correction. The Contractor shall correct and return the as-built drawings to the Contracting Officer for approval within ten calendar days from the time the drawings are returned to the Contractor.

Onsite Tests; G.

A detailed description of the Contractor's proposed procedures for on-site tests.

SD-06 Test Reports

Factory Test Reports; G.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.

Field Test Plan; G.

A detailed description of the Contractor's proposed procedures for onsite test submitted 30 days prior to testing the installed system. No field test will be performed until the test plan is approved. The test plan shall consist of complete field test procedures including tests to be performed, test equipment required, and tolerance limits.

Field Test Reports; G.

Six copies of the information described below in 216 x 280 mm binders having a minimum of 5 rings from which material may readily be removed and replaced, including a separate section for each test. Sections shall be separated by heavy plastic dividers with tabs.

- a. A list of equipment used, with calibration certifications.
- b. A copy of measurements taken.
- c. The dates of testing.
- d. The equipment and values to be verified.
- e. The conditions specified for the test.
- f. The test results, signed and dated.
- g. A description of adjustments made.
- h. Final position of controls and device settings.

SD-07 Certificates

Materials and Equipment;

The label or listing of the Underwriters Laboratories, Inc., will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from other testing agency is specifically approved in writing by the Contracting Officer. Items which are required to be listed and labeled in accordance with Underwriters Laboratories must be affixed with a UL label that states that it is UL listed. No exceptions or waivers will be granted to this requirement. Materials and equipment will be approved based on the manufacturer's published data.

For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or other commercial standard, is acceptable.

1.4 WORKMANSHIP

Materials and equipment shall be installed in accordance with NFPA 70, recommendations of the manufacturer, and as shown.

1.5 SEISMIC REQUIREMENTS

Seismic details shall conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

Products shall conform to the respective publications and other requirements specified below. Materials and equipment not listed below shall be as specified elsewhere in this section. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.1 CABLES AND WIRES

Conductors No. 8 AWG and larger diameter shall be stranded. Conductors No. 10 AWG and smaller diameter shall be solid, except that conductors for remote control, alarm, and signal circuits, classes 1, 2, and 3, shall be stranded unless specifically indicated otherwise. Conductor sizes and ampacities shown are based on copper, unless indicated otherwise. All conductors shall be copper.

2.1.1 Equipment Manufacturer Requirements

When manufacturer's equipment requires copper conductors at the terminations or requires copper conductors to be provided between components of equipment, provide copper conductors or splices, splice boxes, and other work required to meet manufacturer's requirements.

2.1.2 Aluminum Conductors

Aluminum conductors shall not be used.

2.1.3 Insulation

Unless indicated otherwise, or required by NFPA 70, power and lighting wires shall be 600-volt, Type THWN, THHN, or THW conforming to UL 83, except that grounding wire may be type TW conforming to UL 83; remote-control and signal circuits shall be Type TW, THW or TF, conforming to UL 83. Where lighting fixtures require 90-degree Centigrade (C) conductors, provide only conductors with 90-degree C insulation or better.

2.1.4 Bonding Conductors

ASTM B 1, solid bare copper wire for sizes No. 8 AWG and smaller diameter; ASTM B 8, Class B, stranded bare copper wire for sizes No. 6 AWG and larger diameter.

2.1.5 Service Entrance Cables

Service entrance (SE) and underground service entrance (USE) cables, UL 854.

2.1.6 Cord Sets and Power-Supply Cords

UL 817.

2.2 CABLE TRAYS

Cable trays shall conform to NEMA VE 1 and shall be of nominal 100 mm (4 inch) depth. Cable trays shall be constructed of zinc-coated steel. Trays shall include splice and end plates, dropouts, and miscellaneous hardware. Edges, fittings, and hardware shall be finished free from burrs and sharp edges. Fittings shall have not less than the load-carrying ability of straight tray sections and shall have manufacturer's minimum standard radius. Radius of bends shall be 305 mm. (12 inches).

2.2.1 Ladder

Ladder-type cable tray width shall be as shown. Rung spacing shall be on 230 mm (9 inch) maximum centers.

2.3 TRANSIENT VOLTAGE SURGE PROTECTION

Transient voltage surge suppressors shall be provided as indicated. Surge suppressors shall meet the requirements of IEEE C62.41 and be UL listed and labeled as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 208/120 volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground; transient suppression voltage (peak let-through voltage) of 330 volts for 208/120 volt systems and 700 volts for 480/277 volt systems as applicable. Fuses shall not be used as surge suppression.

2.4 CIRCUIT BREAKERS

2.4.1 MOLDED-CASE CIRCUIT BREAKERS

Molded-case circuit breakers shall conform to NEMA AB 1 and UL 489. Circuit breakers may be installed in panelboards, switchboards, enclosures, motor control centers, or combination motor controllers.

2.4.1.1 Construction

Circuit breakers shall be suitable for mounting and operating in any position. Lug shall be listed for copper conductors only in accordance with UL 486E. Single-pole circuit breakers shall be full module size with not more than one pole per module. Multi-pole circuit breakers shall be of the common-trip type having a single operating handle such that an overload or short circuit on any one pole will result in all poles opening simultaneously. Sizes of 100 amperes or less may consist of single-pole breakers permanently factory assembled into a multi-pole unit having an internal, mechanical, nontamperable common-trip mechanism and external handle ties. All circuit breakers shall have a quick-make, quick-break overcenter toggle-type mechanism, and the handle mechanism shall be trip-free to prevent holding the contacts closed against a short-circuit or sustained overload. All circuit breaker handles shall assume a position between "ON" and "OFF" when tripped automatically. All ratings shall be clearly visible.

2.4.1.2 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. The interrupting rating of the circuit breakers shall be at least equal to the available short-circuit current at the line terminals of the circuit breaker and correspond to the UL listed integrated short-circuit current rating specified for the panelboards and switchboards. Molded-case circuit breakers shall have nominal voltage ratings, maximum continuous-current ratings, and maximum short-circuit interrupting ratings in accordance with NEMA AB 1. Ratings shall be coordinated with system X/R ratio.

2.4.1.3 Thermal-Magnetic Trip Elements

Thermal magnetic circuit breakers shall be provided as shown. Automatic operation shall be obtained by means of thermal-magnetic tripping devices located in each pole providing inverse time delay and instantaneous circuit protection. The instantaneous magnetic trip shall be adjustable and accessible from the front of all circuit breakers on frame sizes above 150 amperes.

2.4.2 SWD Circuit Breakers

Circuit breakers rated 15 amperes and intended to switch 277 volts or less fluorescent lighting loads shall be marked "SWD."

2.4.3 HACR Circuit Breakers

Circuit breakers 60 amperes or below, 240 volts, 1-pole or 2-pole, intended to protect multi-motor and combination-load installations involved in heating, air conditioning, and refrigerating equipment shall be marked "Listed HACR Type."

2.4.4 Ground Fault Circuit Interrupters

UL 943. Breakers equipped with ground fault circuit interrupters shall have ground fault class, interrupting capacity, and voltage and current ratings as indicated.

2.5 CONDUIT AND TUBING

2.5.1 Electrical, Zinc-Coated Steel Metallic Tubing (EMT)

UL 797

2.5.2 Flexible Conduit, Steel and Plastic

General-purpose type, UL 1; liquid tight, UL 360, and UL 1660.

2.5.3 Intermediate Metal Conduit

UL 1242.

2.5.4 PVC Coated Rigid Steel Conduit

NEMA RN 1.

2.5.5 Rigid Metal Conduit

UL 6.

2.5.6 Rigid Plastic Conduit

NEMA TC 2, UL 651 and UL 651A.

2.5.7 Surface Metal Electrical Raceways and Fittings

UL 5.

2.6 CONDUIT AND DEVICE BOXES AND FITTINGS

2.6.1 Boxes, Metallic Outlet

NEMA OS 1 and UL 514A.

2.6.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.6.3 Boxes, Switch (Enclosed), Surface-Mounted

UL 98.

2.6.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.6.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7 CONDUIT COATINGS PLASTIC RESIN SYSTEM

NEMA RN 1, Type A-40.

2.8 CONNECTORS, WIRE PRESSURE

2.8.1 For Use With Copper Conductors

UL 486A.

2.9 ELECTRICAL GROUNDING AND BONDING EQUIPMENT

UL 467.

2.9.1 Ground Rods

Ground rods shall be of copper-clad steel conforming to UL 467 not less than 19.1 mm in diameter by 3.1 meter in length of the sectional type driven full length into the earth.

2.9.2 Ground Bus

The ground bus shall be bare conductor or flat copper in one piece, if practicable.

2.10 ENCLOSURES

NEMA ICS 6 or NEMA 250

2.10.1 Cabinets and Boxes

Cabinets and boxes with volume greater than 0.0164 cubic meters (100 cubic inches) shall be in accordance with UL 50, hot-dip, zinc-coated, if sheet steel.

2.10.2 Circuit Breaker Enclosures

UL 489.

2.11 LIGHTING FIXTURES, LAMPS, BALLASTS, EMERGENCY EQUIPMENT, CONTROLS AND ACCESSORIES

The following specifications are supported and supplemented by information and details on the drawings. Additional fixtures, if shown, shall conform to this specification. Lamps, lampholders, ballasts, transformers, electronic circuitry and other lighting system components shall be constructed according to industry standards. Equipment shall be tested and listed by a recognized independent

testing laboratory for the expected installation conditions. Equipment shall conform to the standards listed below.

2.11.1 Lamps

Lamps shall be constructed to operate in the specified fixture, and shall function without derating life or output as listed in published data. Lamps shall meet the requirements of the Energy Policy Act of 1992. All linear fluorescent, compact fluorescent, and high intensity discharge lamps shall be certified by the Washington Department of Ecology as a "non-hazardous waste" in the state of Washington. Contractor shall submit a letter from the Department of Ecology for all lamps to be used in the project.

- a. Incandescent and tungsten halogen lamps shall be designed for 125 volt operation (except for low voltage lamps), shall be rated for minimum life of 2,000 hours, and shall have color temperature between 2,800 and 3,200 degrees Kelvin. Tungsten halogen lamps shall incorporate quartz capsule construction. Lamps shall comply with ANSI C78.20 and sections 238 and 270 of ANSI C78.21.
- b. Fluorescent lamps shall have color temperature as shown. They shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used. Fluorescent lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. Fluorescent lamps shall comply with ANSI C78.1. Fluorescent tube lamp efficiencies shall meet or exceed the following requirements.

T8, 32 watts	(4' lamp)	2800 lumens
T8/U,31-32 watts	(U-tube)	2600 lumens

(1) Linear fluorescent lamps, unless otherwise indicated, shall be 1219 mm long 32 watt T8, 265 mA, with minimum CRI of 75. Lamps of other lengths or types shall be used only where specified or shown. Lamps shall deliver rated life when operated on ballasts as shown.

(2) Small compact fluorescent lamps shall be twin, double, or triple tube configuration as shown with bi-pin or four-pin snap-in base and shall have minimum CRI of 85. They shall deliver rated life when operated on ballasts as shown. 9 and 13 watt double tube lamps shall comply with ANSI C78.2B. 18 and 26 watt double tube lamps shall comply with ANSI C78.2A. Minimum starting temperature shall be 0 degrees C (32 degrees F) for twin tube lamps and for double and triple twin tube lamps without internal starter; and -9 degrees C (15 degrees F) for double and triple twin tube lamps with internal starter.

- c. High intensity discharge lamps, including spares, shall be manufactured by one manufacturer in order to provide color and performance consistency. High intensity discharge lamps shall be designed to operate with the ballasts and circuitry of the fixtures in which they will be used and shall have wattage, shape and base as shown. High intensity discharge lamps, unless otherwise shown, shall have medium or mogul screw base and minimum starting temperature of -29 degrees C. Metal halide lamps, unless otherwise shown, shall have minimum CRI of 65; color temperature of 4,300 degrees Kelvin; shall be -BU configuration if used in base-up position; and shall be -H or high output configuration if used in horizontal position. Lamps shall comply with all applicable ANSI C78.1350, ANSI C78.1351, ANSI C78.1352, ANSI C78.1355, ANSI C78.1375, and ANSI C78.1376.

2.11.2 Ballasts and Transformers

Ballasts or transformers shall be designed to operate the designated lamps within their optimum specifications, without derating the lamps. Lamp and ballast combinations shall be certified as acceptable by the lamp manufacturer.

- a. Fluorescent ballasts shall comply with ANSI C82.1 and shall be mounted integrally within fluorescent fixture housing unless otherwise shown. Ballasts shall have maximum current crest factor of 1.7; high power factor; Class A sound rating; maximum operating case temperature of 25 degrees C above ambient; and shall be rated Class P. Unless otherwise indicated, the minimum number of ballasts shall be used to serve each individual fixture. A single ballast may be used to serve multiple fixtures if they are continuously mounted, identically controlled and factory manufactured for that installation with an integral wireway.

(1) Compact fluorescent ballasts shall comply with IEEE C62.41 Category A transient voltage variation requirements and shall be mounted integrally within compact fluorescent fixture housing unless otherwise shown. Ballasts shall have minimum ballast factor of 0.95; maximum current crest factor of 1.6; high power factor; maximum operating case temperature of 25 degrees C above ambient; shall be rated Class P; and shall have a sound rating of Class A. Ballasts shall meet FCC Class A specifications for EMI/RFI emissions. Ballasts shall operate from nominal line voltage of 120 or 277 volts as applicable at 60 Hz and maintain constant light output over a line voltage variation of $\pm 10\%$. Ballasts shall have an end-of-lamp-life detection and shut-down circuit. Ballasts shall be UL listed and shall contain no PCBs. Ballasts shall contain potting to secure PC board, provide lead strain relief, and provide a moisture barrier.

(2) Electronic fluorescent ballasts shall comply with 47 CFR 18 for electromagnetic interference. Ballasts shall withstand line transients per IEEE C62.41, Category A. Ballasts shall have total harmonic distortion between 10 and 20%; minimum frequency of 20,000Hz; filament voltage between 2.5 and 4.5 volts; maximum starting inrush current of 20 amperes; and shall comply with the minimum Ballast Efficacy Factors shown in the table below. Minimum starting temperature shall be 10 degrees C. Ballasts shall carry a manufacturer's full warranty of three years, including a minimum \$10 labor allowance per ballast.

ELECTRONIC FLUORESCENT BALLAST EFFICACY FACTORS

LAMP TYPE	TYPE OF STARTER & LAMP	NOMINAL OPERATIONAL VOLTAGE	NUMBER OF LAMPS	MINIMUM BALLAST EFFICACY FACTOR
32W T8	rapid	120 or 277 V	1	2.54
	start		2	1.44
	linear &		3	0.93
	U-tubes		4	0.73

- b. High intensity discharge ballasts shall comply with UL 1029 and, if multiple supply types, with ANSI C82.4. Ballasts shall have minimum ballast factor of 0.9; high power factor; Class A sound rating; and maximum operating case temperature of 25 degrees C above ambient.

(1) Electronic high intensity discharge ballasts shall be constant wattage autotransformer type; shall have less than 10% ballast loss; shall have total harmonic distortion between 10 and 20%; and shall have a minimum starting temperature of -18 degrees C .

2.11.3 Fixtures

Fixtures shall be in accordance with the size, shape, appearance, finish, and performance shown. Unless otherwise indicated, lighting fixtures shall be provided with housings, junction boxes, wiring, lampholders, mounting supports, trim, hardware and accessories for a complete and operable installation. Recessed housings shall be minimum 20 gauge cold rolled or galvanized steel as shown. Extruded aluminum fixtures shall have minimum wall thickness of 3 mm. Plastic lenses shall be 100%

virgin acrylic or as shown. Glass lenses shall be tempered. Heat resistant glass shall be borosilicate type. Conoid recessed reflector cones shall be Alzak with clear specular low iridescent finish.

- a. Fluorescent fixtures shall comply with UL 1570. Recessed ceiling fixtures shall comply with NEMA LE 4. Fixtures shall be plainly marked for proper lamp and ballast type to identify lamp diameter, wattage, color and start type. Marking shall be readily visible to service personnel, but not visible from normal viewing angles. Fluorescent fixture lens frames on recessed and surface mounted troffers shall be one assembly with mitered corners. Parabolic louvers shall have a low iridescent finish and 45 degree cut-off. Louver intersection joints shall be hairline type and shall conceal mounting tabs or other assembly methods. Louvers shall be free from blemishes, lines or defects which distort the visual surface. Integral ballast and wireway compartments shall be easily accessible without the use of special tools. Housings shall be constructed to include grounding necessary to start the lamps. Open fixtures shall be equipped with a sleeve, wire guard, or other positive means to prevent lamps from falling. Medium bi-pin lampholders shall be twist-in type with positive locking position. Long compact fluorescent fixtures and fixtures utilizing U-bend lamps shall have clamps or secondary lampholders to support the free ends of the lamps.
- b. High intensity discharge fixture shall comply with UL 1572. Recessed ceiling fixtures shall comply with NEMA LE 4. Reflectors shall be anodized aluminum. Fixtures for horizontal lamps shall have position oriented lampholders. Lampholders shall be pulse-rated to 5,000 volts. Fixtures indicated as classified or rated for hazardous locations or special service shall be designed and independently tested for the environment in which they are installed. Recessed lens fixtures shall have extruded aluminum lens frames. Ballasts shall be integral to fixtures and shall be accessible without the use of special tools. Remote ballasts shall be encased and potted. Lamps shall be shielded from direct view with a UV absorbing material such as tempered glass, and shall be circuited through a cut-off switch which will shut off the lamp circuit if the lens is not in place.
- c. Exit Signs shall be ENERGY STAR compliant, thereby meeting the following requirements. Input power shall be less than 5 watts per face. Letter size and spacing shall adhere to NFPA 101. Luminance contrast shall be greater than 0.8. Average luminance shall be greater than 15 cd/m² measured at normal (0 degree) and 45 degree viewing angles. Minimum luminance shall be greater than 8.6 cd/m² measured at normal and 45 degree viewing angles. Maximum to minimum luminance shall be less than 20:1 measured at normal and 45 degree viewing angles. The manufacturer warranty for defective parts shall be at least 5 years. All exit signs shall have red letters.

2.11.4 Lampholders, Starters, and Starter Holders

UL 542

2.11.5 Ultrasonic, and Passive Infrared Occupancy Sensors

UL 916

2.11.6 Emergency Lighting System

UL 924

2.12 LOW-VOLTAGE FUSES AND FUSEHOLDERS

2.12.1 Fuses, Low Voltage Cartridge Type

NEMA FU 1.

2.12.2 Fuses, High-Interrupting-Capacity, Current-Limiting Type

Fuses, Class G, J, L and CC shall be in accordance with UL 198C.

2.12.3 Fuses, Class K, High-Interrupting-Capacity Type

UL 198D.

2.12.4 Fuses, Class H

UL 198B.

2.12.5 Fuses, Class R

UL 198E.

2.12.6 Fuses, Class T

UL 198H.

2.12.7 Fuses for Supplementary Overcurrent Protection

UL 198G.

2.12.8 Fuses, D-C for Industrial Use

UL 198L.

2.12.9 Fuseholders

UL 512.

2.13 INSTRUMENTS, ELECTRICAL INDICATING

ANSI C39.1.

2.14 MOTORS, AC, FRACTIONAL AND INTEGRAL

Motors, ac, fractional and integral kilowatt, horsepower, 373.0 kW (500 hp) and smaller shall conform to NEMA MG 1 and UL 1004 for motors; NEMA MG 10 for energy management selection of polyphase motors. In addition to the standards listed above, motors shall be provided with efficiencies as specified in the table "MINIMUM NOMINAL EFFICIENCIES" below.

2.14.1 Rating

The kilowatt (horsepower) rating of motors should be limited to no more than 125 percent of the maximum load being served unless a NEMA standard size does not fall within this range. In this case, the next larger NEMA standard motor size should be used.

2.14.2 Motor Efficiencies

All permanently wired polyphase motors of 746 W (1 hp) or more shall meet the minimum full-load efficiencies as indicated in the following table, and as specified in this specification. Motors of 746 W (1 hp) or more with open, drip proof or totally enclosed fan cooled enclosures shall be high efficiency type, unless otherwise indicated. Motor efficiencies indicated in the tables apply to general-purpose, single-speed, polyphase induction motors. Applications which require definite purpose, special

purpose, special frame, or special mounted polyphase induction motors are excluded from these efficiency requirements. Motors provided as an integral part of motor driven equipment are excluded from this requirement if a minimum seasonal or overall efficiency requirement is indicated for that equipment by the provisions of another section.

MINIMUM NOMINAL MOTOR EFFICIENCIES
OPEN DRIP PROOF MOTORS

<u>kW</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
0.746	82.5	85.5	80.0
1.12	86.5	86.5	85.5
1.49	87.5	86.5	86.5
2.24	89.5	89.5	86.5
3.73	89.5	89.5	89.5
5.60	91.7	91.0	89.5
7.46	91.7	91.7	90.2
11.2	92.4	93.0	91.0
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	93.6
44.8	95.0	95.0	94.1
56.9	95.0	95.0	94.5
74.6	95.0	95.4	94.5
93.3	95.4	95.4	95.0
112.0	95.8	95.8	95.4
149.0	95.4	95.8	95.4
187.0	95.4	96.2	95.8
224.0	95.4	95.0	95.4
261.0	94.5	95.4	95.0
298.0	94.1	95.8	95.0
336.0	94.5	95.4	95.4
373.0	94.5	94.5	94.5

TOTALLY ENCLOSED FAN-COOLED MOTORS

<u>kW</u>	<u>1200 RPM</u>	<u>1800 RPM</u>	<u>3600 RPM</u>
0.746	82.5	85.5	78.5
1.12	87.5	86.5	85.5
1.49	88.5	86.5	86.5
2.24	89.5	89.5	88.5
3.73	89.5	89.5	89.5
5.60	91.7	91.7	91.0
7.46	91.7	91.7	91.7
11.2	92.4	92.4	91.7
14.9	92.4	93.0	92.4
18.7	93.0	93.6	93.0
22.4	93.6	93.6	93.0
29.8	94.1	94.1	93.6
37.3	94.1	94.5	94.1
44.8	94.5	95.0	94.1
56.9	95.0	95.4	94.5
74.6	95.4	95.4	95.0
93.3	95.4	95.4	95.4
112.0	95.8	95.8	95.4
149.0	95.8	96.2	95.8
187.0	95.6	96.2	95.9
224.0	95.4	96.1	95.8
261.0	94.5	96.2	94.8
298.0	94.5	95.8	94.5
336.0	94.5	94.5	94.5
373.0	94.5	94.5	94.5

2.15 MOTOR CONTROLS AND MOTOR CONTROL CENTERS

2.15.1 General

NEMA ICS 1, NEMA ICS 2, NEMA ICS 3 and NEMA ICS 6, and UL 508 and UL 845. Panelboards supplying non-linear loads shall have neutrals sized for 200 percent of rated current.

2.15.2 Motor Starters

Combination starters shall be provided with fusible switches.

2.15.3 Thermal-Overload Protection

Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating.

2.15.4 Low-Voltage Motor Overload Relays

2.15.4.1 General

Thermal overload relays shall conform to NEMA ICS 2 and UL 508. Overload protection shall be provided either integral with the motor or motor controller, and shall be rated in accordance with the requirements of NFPA 70.

2.15.4.2 Construction

Manual reset type thermal relay shall be bimetallic construction. Automatic reset type thermal relays shall be bimetallic construction. Magnetic current relays shall consist of a contact mechanism and a dash pot mounted on a common frame.

2.15.4.3 Ratings

Voltage ratings shall be not less than the applicable circuit voltage. Trip current ratings shall be established by selection of the replaceable overload device and shall not be adjustable. Where the controller is remotely-located or difficult to reach, an automatic reset, non-compensated overload relay shall be provided. Manual reset overload relays shall be provided otherwise, and at all locations where automatic starting is provided. Where the motor is located in a constant ambient temperature, and the thermal device is located in an ambient temperature that regularly varies by more than minus 10 degrees C. an ambient temperature-compensated overload relay shall be provided.

2.15.5 Automatic Control Devices

2.15.5.1 Direct Control

Automatic control devices (such as thermostats, float or pressure switches) which control the starting and stopping of motors directly shall be designed for that purpose and have an adequate kilowatt (horsepower) rating.

2.15.5.2 Pilot-Relay Control

Where the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit.

2.15.5.3 Manual/Automatic Selection

- a. Where combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch (marked MANUAL-OFF-AUTOMATIC) shall be provided for the manual control.
- b. Where combination manual and automatic control is specified and the automatic-control device actuates the pilot control circuit of a magnetic starter, the magnetic starter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC.
- c. Connections to the selector switch shall be such that; only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low-or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

2.16 PANELBOARDS

Dead-front construction, NEMA PB 1 and UL 67.

2.16 RECEPTACLES

2.16.1 Standard Grade

UL 498.

2.16.2 Ground Fault Interrupters

UL 943, Class A or B.

2.16.3 NEMA Standard Receptacle Configurations

NEMA WD 6.

a. Single and Duplex, 15-Ampere and 20-Ampere, 125 Volt

15-ampere, non-locking: NEMA type 5-15R; locking: NEMA type L5-15R; 20-ampere, non-locking: NEMA type 5-20R; locking: NEMA type L5-20R.

b. 15-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-15R; locking: NEMA type L6-15R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-15R; locking: NEMA type L15-15R.

c. 20-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-20R; locking: NEMA type L6-20R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-20R; locking: NEMA type L15-20R.

d. 30-Ampere, 125/250 Volt

Three-pole, 3-wire, non-locking: NEMA type 10-30R; locking: NEMA type L10-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 14-30R; locking: NEMA type L14-30R.

e. 30-Ampere, 250 Volt

Two-pole, 3-wire grounding, non-locking: NEMA type 6-30R; locking: NEMA type L6-30R. Three-pole, 4-wire grounding, non-locking: NEMA type 15-30R; locking: NEMA type L15-30R.

f. 50-Ampere, 125/250 Volt

Three-pole, 3-wire: NEMA type 10-50R. Three-pole, 4-wire grounding: NEMA type 14-50R.

g. 50-Ampere, 250 Volt

Two-pole, 3-wire grounding: NEMA type 6-50R. Three-pole, 4-wire grounding: NEMA type 15-50R.

2.17 SERVICE ENTRANCE EQUIPMENT

UL 869A.

2.18 SPLICE, CONDUCTOR

UL 486C.

2.19 POWER-SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS

Assemblies shall be metal-enclosed, freestanding general-purpose type in accordance with NEMA PB 2, UL 891, and IEEE C37.20.1 and shall be installed to provide front access. Busses shall be copper. Assembly shall be approximately 2.3 meters (90 inches) high; arrangement of circuit breakers and other items specified shall be as indicated. The withstand rating and interrupting capacity of the switchboards and circuit breakers shall be based on the maximum fault current available.

2.19.1 Circuit Breakers

Circuit breakers shall be molded-case circuit breakers

2.19.2 Auxiliary Equipment

2.19.2.1 Instruments

Instruments shall be long scale, 173 mm (6.8 inches) minimum, semiflush rectangular, indicating or digital switchboard type, mounted at eye level.

- a. Ammeter, range 0 to 3000 amperes, complete with selector switch having off position and positions to read each phase current.
- b. Voltmeter, range 0 to 250 volts, complete with selector switch having off position and positions to read each phase to phase voltage.

2.20 SNAP SWITCHES

UL 20.

2.21 TAPES

2.21.1 Plastic Tape

UL 510.

2.21.2 Rubber Tape

UL 510.

2.22 TRANSFORMERS

Single- and three-phase transformers shall have two windings per phase. Full-capacity standard NEMA taps shall be provided in the primary windings of transformers unless otherwise indicated. Three-phase transformers shall be configured with delta-wye windings. "T" connections may be used for transformers rated 15 kVA or below. Transformers supplying non-linear loads shall be UL listed as suitable for supplying such loads with a total K-factor not to exceed K-4 and have neutrals sized for 200 percent of rated current.

2.22.1 Transformers, Dry-Type

Transformers shall have 220 degrees C insulation system for transformers 15 kVA and greater, and shall have 180 degrees C insulation system for transformers rated 10 kVA and less, with temperature

rise not exceeding 150 degrees C under full-rated load in maximum ambient temperature of 40 degrees C. Transformer of 150 degrees C temperature rise shall be capable of carrying continuously 100 percent of nameplate kVA without exceeding insulation rating.

a. 600 Volt or Less Primary:

NEMA ST 20, UL 506, general purpose, dry-type, self-cooled, ventilated. Transformers shall be provided in NEMA 1 enclosure. Transformers shall be quiet type with maximum sound level at least 3 decibels less than NEMA standard level for transformer ratings indicated.

2.22.2 Average Sound Level

The average sound level in decibels (dB) of transformers shall not exceed the following dB level at 300 mm (12 inches) for the applicable kVA rating range listed unless otherwise indicated:

kVA Range	dB Sound Level
1-50	50
51-150	55
151-300	58
301-500	60
501-700	62
701-1000	64
1001-1500	65
1501 & above	70

2.23 ISOLATED POWER SYSTEM EQUIPMENT

UL 1047 with monitor UL 1022.

2.24 WATTHOUR METERS

Watt-hour meters shall conform to the requirements of Section 15910 DIRECT DIGITAL CONTROL SYSTEMS.

2.26 INSTRUMENT TRANSFORMERS

2.26.1 General

Instrument transformers shall comply with IEEE C57.13. Instrument transformers shall be configured for mounting in/on the device to which they are applied. Polarity marks on instrument transformers shall be visually evident and shown on drawings.

2.26.2 Current Transformers

Unless otherwise indicated, bar, wound, or window-type transformers are acceptable; and except for window-type units installed over insulated buses, transformers shall have a BIL rating consistent with the rated BIL of the associated switchgear or electric power apparatus bushings, buses or conductors. Current transformers shall have the indicated ratios. The continuous thermal-current rating factor shall be not less than 1.0. Other thermal and mechanical ratings of current transformer and their primary leads shall be coordinated with the design of the circuit breaker and shall be not less than the momentary rating of the associated circuit breaker. Circuit protectors shall be provided across secondary leads of the current transformers to prevent the accidental open-circuiting of the transformers while energized. Each terminal of each current transformer shall be connected to a short-

circuiting terminal block in the circuit interrupting mechanism cabinet, power transformer terminal cabinet, and in the associated instrument and relay cabinets.

2.26.3 Voltage Transformers

Voltage transformers shall have indicated ratios. Units shall have an accuracy class rating of 0.3. Voltage transformers shall be of the drawout type having current-limiting fuses in both primary and secondary circuits. Mechanical interlocks shall prevent removal of fuses, unless the associated voltage transformer is in a drawout position. Voltage transformer compartments shall have hinged doors.

2.27 WIRING DEVICES

NEMA WD 1 for wiring devices, and NEMA WD 6 for dimensional requirements of wiring devices.

2.28 LIQUID-DIELECTRICS

Liquid dielectrics for transformers, capacitors, and other liquid-filled electrical equipment shall be non-polychlorinated biphenyl (PCB) mineral oil or less flammable liquid as specified. Nonflammable fluids shall not be used. Tetrachloroethylene (perchloroethylene) and 1, 2, 4 trichlorobenzene fluids shall be certified by the manufacturer as having less than 2 parts per million (ppm) PCB content. In lieu of the manufacturer's certification, the Contractor may submit a test sample of the dielectric in accordance with ASTM D 4059 at a testing facility approved by the Contracting Officer. Equipment with test results indicating PCB level exceeding 2 ppm shall be replaced.

PART 3 EXECUTION

3.1 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following specifications.

3.1.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground shall not exceed 25 ohms under normally dry conditions. If this resistance cannot be obtained with a single rod, three additional rods not less than 1.8 meters on centers, or if sectional type rods are used, two (2) additional sections may be coupled and driven with the first rod. In high-ground-resistance, UL listed chemically charged ground rods may be used. If the resultant resistance exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.1.2 Ground Bus

Ground bus shall be provided in the electrical equipment rooms as indicated. Noncurrent-carrying metal parts of transformer neutrals and other electrical equipment shall be effectively grounded by bonding to the ground bus. The ground bus shall be bonded to both the entrance ground, and to a ground rod or rods as specified above having the upper ends terminating approximately 100 mm above the floor. Connections and splices shall be of the brazed, welded, bolted, or pressure-connector type, except that pressure connectors or bolted connections shall be used for connections to removable equipment. For raised floor equipment rooms in computer and data processing centers, a minimum of 4, one at each corner, multiple grounding systems shall be furnished. Connections shall be bolted type in lieu of thermoweld, so they can be changed as required by additions and/or alterations.

3.1.3 Grounding Conductors

A green equipment grounding conductor, sized in accordance with NFPA 70 shall be provided, regardless of the type of conduit. Equipment grounding bars shall be provided in all panelboards. The equipment grounding conductor shall be carried back to the service entrance grounding connection or separately derived grounding connection. All equipment grounding conductors, including metallic raceway systems used as such, shall be bonded or joined together in each wiring box or equipment enclosure. Metallic raceways and grounding conductors shall be checked to assure that they are wired or bonded into a common junction. Metallic boxes and enclosures, if used, shall also be bonded to these grounding conductors by an approved means per NFPA 70. When switches, or other utilization devices are installed, any designated grounding terminal on these devices shall also be bonded to the equipment grounding conductor junction with a short jumper.

3.2 WIRING METHODS

Wiring shall conform to NFPA 70, the contract drawings, and the following specifications. Unless otherwise indicated, wiring shall consist of insulated conductors installed in rigid zinc coated steel conduit, rigid plastic conduit, electrical metallic tubing, and intermediate metal conduit. Where cables and wires are installed in cable trays, they shall be of the type permitted by NFPA 70 for use in such applications. Wire fill in conduits shall be based on NFPA 70 for the type of conduit and wire insulations specified.

3.2.1 Conduit and Tubing Systems

Conduit and tubing systems shall be installed as indicated. Conduit sizes shown are based on use of copper conductors with insulation types as described in paragraph WIRING METHODS. Minimum size of raceways shall be 15 mm. Only metal conduits will be permitted when conduits are required for shielding or other special purposes indicated, or when required by conformance to NFPA 70. Electrical metallic tubing (EMT) may be installed only within buildings. EMT shall not be installed in concrete, damp or wet locations, or the air space of exterior masonry cavity walls. Bushings, manufactured fittings or boxes providing equivalent means of protection shall be installed on the ends of all conduits and shall be of the insulating type, where required by NFPA 70. Only UL listed adapters shall be used to connect EMT to rigid metal conduit, cast boxes, and conduit bodies. Penetrations of above grade floor slabs, time-rated partitions and firewalls shall be firestopped in accordance with Section 07840 FIRESTOPPING. Except as otherwise specified, IMC may be used as an option for rigid steel conduit in areas as permitted by NFPA 70. Raceways shall not be installed under the firepits of boilers and furnaces and shall be kept 150 mm away from parallel runs of flues, steam pipes and hot-water pipes. Raceways shall be concealed within finished walls, ceilings, and floors unless otherwise shown. Raceways crossing structural expansion joints or seismic joints shall be provided with suitable expansion fittings or other suitable means to compensate for the building expansion and contraction and to provide for continuity of grounding. Wiring installed in underfloor duct system shall be suitable for installation in wet locations.

3.2.1.1 Pull Wires

A pull wire shall be inserted in each empty raceway in which wiring is to be installed if the raceway is more than 15 meters in length and contains more than the equivalent of two 90-degree bends, or where the raceway is more than 45 meters in length. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200 psi) tensile strength. Not less than 254 mm of slack shall be left at each end of the pull wire.

3.2.1.2 Conduit Stub-Ups

Where conduits are to be stubbed up through concrete floors, a short elbow shall be installed below grade to transition from the horizontal run of conduit to a vertical run. A conduit coupling fitting, threaded on the inside shall be installed, to allow terminating the conduit flush with the finished floor.

Wiring shall be extended in rigid threaded conduit to equipment, except that where required, flexible conduit may be used 150 mm above the floor. Empty or spare conduit stub-ups shall be plugged flush with the finished floor with a threaded, recessed plug.

3.2.1.3 Below Slab-on-Grade or in the Ground

Electrical wiring below slab-on-grade shall be protected by a conduit system. Conduit passing vertically through slabs-on-grade shall be rigid steel or IMC. Rigid steel or IMC conduits installed below slab-on-grade or in the earth shall be field wrapped with 0.254 mm thick pipe-wrapping plastic tape applied with a 50 percent overlay, or shall have a factory-applied polyvinyl chloride, plastic resin, or epoxy coating system.

3.2.1.4 Installing in Slabs Including Slabs on Grade

Conduit installed in slabs including slabs-on-grade shall be rigid steel or IMC. Conduits shall be installed as close to the middle of concrete slabs as practicable without disturbing the reinforcement. Outside diameter shall not exceed 1/3 of the slab thickness and conduits shall be spaced not closer than 3 diameters on centers except at cabinet locations where the slab thickness shall be increased as approved by the Contracting Officer. Where conduit is run parallel to reinforcing steel, the conduit shall be spaced a minimum of one conduit diameter away but not less than 25.4 mm from the reinforcing steel.

3.2.1.5 Changes in Direction of Runs

Changes in direction of runs shall be made with symmetrical bends or cast-metal fittings. Field-made bends and offsets shall be made with an approved hickey or conduit-bending machine. Crushed or deformed raceways shall not be installed. Trapped raceways in damp and wet locations shall be avoided where possible. Lodgment of plaster, dirt, or trash in raceways, boxes, fittings and equipment shall be prevented during the course of construction. Clogged raceways shall be cleared of obstructions or shall be replaced.

3.2.1.6 Supports

Metallic conduits and tubing, and the support system to which they are attached, shall be securely and rigidly fastened in place to prevent vertical and horizontal movement at intervals of not more than 3 meters (10 feet) and within 900 mm of boxes, cabinets, and fittings, with approved pipe straps, wall brackets, conduit clamps, conduit hangers, threaded C-clamps, beam clamps, or ceiling trapeze. Loads and supports shall be coordinated with supporting structure to prevent damage or deformation to the structure. Loads shall not be applied to joist bridging. Attachment shall be by wood screws or screw-type nails to wood; by toggle bolts on hollow masonry units; by expansion bolts on concrete or brick; by machine screws, welded threaded studs, heat-treated or spring-steel-tension clamps on steel work. Nail-type nylon anchors or threaded studs driven in by a powder charge and provided with lock washers and nuts may be used in lieu of expansion bolts or machine screws. Raceways or pipe straps shall not be welded to steel structures. Cutting the main reinforcing bars in reinforced concrete beams or joists shall be avoided when drilling holes for support anchors. Holes drilled for support anchors, but not used, shall be filled. In partitions of light steel construction, sheet-metal screws may be used. Raceways shall not be supported using wire or nylon ties. Raceways shall be independently supported from the structure. Upper raceways shall not be used as a means of support for lower raceways. Supporting means shall not be shared between electrical raceways and mechanical piping or ducts. Cables and raceways shall not be supported by ceiling grids. Except where permitted by NFPA 70, wiring shall not be supported by ceiling support systems. Conduits shall be fastened to sheet-metal boxes and cabinets with two locknuts where required by NFPA 70, where insulating bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, a single locknut and bushing may be used. Threadless fittings for electrical metallic tubing shall be of a type approved for the conditions encountered. Additional support for horizontal runs is not required when EMT rests on steel stud cutouts.

3.2.1.7 Exposed Raceways

Exposed raceways shall be installed parallel or perpendicular to walls, structural members, or intersections of vertical planes and ceilings. Raceways under raised floors and above accessible ceilings shall be considered as exposed installations in accordance with NFPA 70 definitions.

3.2.1.8 Exposed Risers

Exposed risers in wire shafts of multistory buildings shall be supported by U-clamp hangers at each floor level, and at intervals not to exceed 3 meters.

3.2.1.9 Exposed Lengths of Conduit, Over 600 Volts

Exposed lengths of conduit containing power conductors operating at more than 600 volts shall have two red bands 50 mm wide spaced 200 mm apart painted near each coupling; the intervening space between the red bands shall be painted white, and on the white space the voltage shall be stenciled in black: 13,800 volts.

3.2.1.10 Communications Raceways

Communications raceways indicated shall be installed in accordance with the previous requirements for conduit and tubing and with the additional requirement that no length of run shall exceed 30 meters for 25 mm or larger sizes, and shall not contain more than two 90-degree bends or the equivalent. Additional pull or junction boxes shall be installed to comply with these limitations whether or not indicated. Inside radii of bends in conduits of 25 mm (1 inch) size or larger shall not be less than ten times the nominal diameter. Pull wire shall be installed for all communications conduit.

3.2.2 Cable Trays

Cable trays shall be supported in accordance with the recommendations of the manufacturer but at no more than 1.8 meter (6 foot) intervals. Contact surfaces of aluminum connections shall be coated with an antioxidant compound prior to assembly. Adjacent cable tray sections shall be bonded together by connector plates of an identical type as the cable tray sections. The Contractor shall submit the manufacturer's certification that the cable tray system meets all requirements of Article 318 of NFPA 70. The cable tray shall be installed and grounded in accordance with the provisions of Article 318 of NFPA 70. Data submitted by the Contractor shall demonstrate that the completed cable tray systems will comply with the specified requirements. Cable trays shall terminate 250 mm from both sides of smoke and fire partitions. Conductors run through smoke and fire partitions shall be installed in 103 mm (4 inch) rigid steel conduits with grounding bushings, extending 300 mm beyond each side of the partitions. The installation shall be sealed to preserve the smoke and fire rating of the partitions. Penetrations shall be firestopped in accordance with Section 07840 FIRESTOPPING.

3.2.3 Cables and Conductors

Installation shall conform to the requirements of NFPA 70. Covered, bare or insulated conductors of circuits rated over 600 volts shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 volts or less.

3.2.3.1 Sizing

Unless otherwise noted, all sizes are based on copper conductors and the insulation types indicated. Sizes shall be not less than indicated. Branch-circuit conductors shall be not smaller than No. 12 AWG. Conductors for branch circuits of 120 volts more than 30 meters long and of 277 volts more than 70 meters long, from panel to load center, shall be no smaller than No. 10 AWG. Class 1 remote control and signal circuit conductors shall be not less than No. 14 AWG. Class 2 remote control and

signal circuit conductors shall be not less than No. 16 AWG. Class 3 low-energy, remote-control and signal circuits shall be not less than No. 22 AWG.

3.2.3.2 Use of Aluminum Conductors in Lieu of Copper

Aluminum conductors shall not be used

3.2.3.3 Cable Splicing

Splices shall be made in an accessible location. Crimping tools and dies shall be approved by the connector manufacturer for use with the type of connector and conductor.

- a. Copper Conductors, 600 Volt and Under: Splices in conductors No. 10 AWG and smaller diameter shall be made with an insulated, pressure-type connector. Splices in conductors No. 8 AWG and larger diameter shall be made with a solderless connector and insulated with tape or heat-shrink type insulating material equivalent to the conductor insulation.
- b. Greater Than 600 Volt: Cable splices shall be made in accordance with the cable manufacturer's recommendations and Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.

3.2.3.5 Conductor Identification and Tagging

Power, control, and signal circuit conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Where several feeders pass through a common pull box, the feeders shall be tagged to indicate clearly the electrical characteristics, circuit number, and panel designation. Phase conductors of low voltage power circuits shall be identified by color coding. Phase identification by a particular color shall be maintained continuously for the length of a circuit, including junctions.

- a. Color coding shall be provided for service, feeder, branch, and ground conductors. Color shall be green for grounding conductors and white for neutrals; except where neutrals of more than one system are installed in the same raceway or box, other neutral shall be white with colored (not green) stripe. The color coding for 3-phase and single-phase low voltage systems shall be as follows:

120/208-volt, 3-phase: Black(A), red(B), and blue(C).
277/480-volt, 3-phase: Brown(A), orange(B), and yellow(C)
- b. Conductor phase and voltage identification shall be made by color-coded insulation for all conductors smaller than No. 6 AWG. For conductors No. 6 AWG and larger, identification shall be made by color-coded insulation, or conductors with black insulation may be furnished and identified by the use of half-lapped bands of colored electrical tape wrapped around the insulation for a minimum of 75 mm of length near the end, or other method as submitted by the Contractor and approved by the Contracting Officer.
- c. Control and signal circuit conductor identification shall be made by color-coded insulated conductors, plastic-coated self-sticking printed markers, permanently attached stamped metal foil markers, or equivalent means as approved. Control circuit terminals of equipment shall be properly identified. Terminal and conductor identification shall match that shown on approved detail drawings. Hand lettering or marking is not acceptable.

3.3 BOXES AND SUPPORTS

Boxes shall be provided in the wiring or raceway systems where required by NFPA 70 for pulling of wires, making connections, and mounting of devices or fixtures. Pull boxes shall be furnished with screw-fastened covers. Indicated elevations are approximate. Unless otherwise indicated, boxes for wall switches shall be mounted 1.2 meters above finished floors. Switch and outlet boxes located on opposite sides of fire rated walls shall be separated by a minimum horizontal distance of 600 mm. The total combined area of all box openings in fire rated walls shall not exceed 0.0645 square meters per 9.3 square meters. Maximum box areas for individual boxes in fire rated walls vary with the manufacturer and shall not exceed the maximum specified for that box in UL Elec Const Dir. Only boxes listed in UL Elec Const Dir shall be used in fire rated walls.

3.3.1 Box Applications

Each box shall have not less than the volume required by NFPA 70 for number of conductors enclosed in box. Boxes for metallic raceways shall be listed for the intended use when located in normally wet locations, when flush or surface mounted on outside of exterior surfaces, or when located in hazardous areas. Boxes installed in wet locations and boxes installed flush with the outside of exterior surfaces shall be gasketed. Boxes for mounting lighting fixtures shall be not less than 102 mm square, or octagonal, except smaller boxes may be installed as required by fixture configuration, as approved. Cast-metal boxes with 2.4 mm wall thickness are acceptable. Large size boxes shall be NEMA 1. Boxes in other locations shall be sheet steel. Boxes for use in masonry-block or tile walls shall be square-cornered, tile-type, or standard boxes having square-cornered, tile-type covers.

3.3.2 Brackets and Fasteners

Boxes and supports shall be fastened to wood with wood screws or screw-type nails of equal holding strength, with bolts and metal expansion shields on concrete or brick, with toggle bolts on hollow masonry units, and with machine screw or welded studs on steel work. Threaded studs driven in by powder charge and provided with lockwashers and nuts, or nail-type nylon anchors may be used in lieu of expansion shields, or machine screws. Penetration of more than 38.1 mm (1-1/2 inches) into reinforced-concrete beams or more than 19.1 mm (3/4 inch) into reinforced-concrete joists shall avoid cutting any main reinforcing steel. The use of brackets which depend on gypsum wallboard or plasterboard for primary support will not be permitted. In partitions of light steel construction, bar hangers with 25 mm long studs, mounted between metal wall studs or metal box mounting brackets shall be used to secure boxes to the building structure. When metal box mounting brackets are used, additional box support shall be provided on the side of the box opposite the brackets. This additional box support shall consist of a minimum 300 mm long section of wall stud, bracketed to the opposite side of the box and secured by two screws through the wallboard on each side of the stud. Metal screws may be used in lieu of the metal box mounting brackets.

3.3.3 Mounting in Walls, Ceilings, or Recessed Locations

In walls or ceilings of concrete, tile, or other non-combustible material, boxes shall be installed so that the edge of the box is not recessed more than 6 mm from the finished surface. Boxes mounted in combustible walls or ceiling material shall be mounted flush with the finished surface. The use of gypsum or plasterboard as a means of supporting boxes will not be permitted. Boxes installed for concealed wiring shall be provided with suitable extension rings or plaster covers, as required. The bottom of boxes installed in masonry-block walls for concealed wiring shall be mounted flush with the top of a block to minimize cutting of the blocks, and boxes shall be located horizontally to avoid cutting webs of block. Separate boxes shall be provided for flush or recessed fixtures when required by the fixture terminal operating temperature, and fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided.

3.3.4 Installation in Overhead Spaces

In open overhead spaces, cast-metal boxes threaded to raceways need not be separately supported except where used for fixture support; cast-metal boxes having threadless connectors and sheet metal boxes shall be supported directly from the building structure or by bar hangers. Hangers shall not be fastened to or supported from joist bridging. Where bar hangers are used, the bar shall be attached to raceways on opposite sides of the box and the raceway shall be supported with an approved type fastener not more than 600 mm from the box.

3.4 DEVICE PLATES

One-piece type device plates shall be provided for all outlets and fittings. Plates on unfinished walls and on fittings shall be of zinc-coated sheet steel, cast-metal, or impact resistant plastic having rounded or beveled edges. Plates on finished walls shall be of impact resistant plastic having rounded or beveled edges and shall be ivory. Screws shall be of metal with countersunk heads, in a color to match the finish of the plate. Plates shall be installed with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 1.6 mm. The use of sectional-type device plates will not be permitted. Plates installed in wet locations shall be gasketed and provided with a hinged, gasketed cover, unless otherwise specified.

3.5 RECEPTACLES

3.5.1 Single and Duplex, 15 or 20-ampere, 125 volt

Single and duplex receptacles shall be rated 20 amperes, 125 volts, two-pole, three-wire, grounding type with polarized parallel slots. Bodies shall be of ivory to match color of switch handles in the same room or to harmonize with the color of the respective wall, and supported by mounting strap having plaster ears. Contact arrangement shall be such that contact is made on two sides of an inserted blade. Receptacle shall be side- or back-wired with two screws per terminal. The third grounding pole shall be connected to the metal mounting yoke. Switched receptacles shall be the same as other receptacles specified except that the ungrounded pole of each suitable receptacle shall be provided with a separate terminal. Only the top receptacle of a duplex receptacle shall be wired for switching application. Receptacles with ground fault circuit interrupters shall have the current rating as indicated, and shall be UL Class A type unless otherwise shown. Ground fault circuit protection shall be provided as required by NFPA 70 and as indicated on the drawings.

3.5.2 Clock Outlet

Clock outlet, for use in other than a wired clock system, shall consist of an outlet box, a plaster cover where required, and a single receptacle with clock-outlet plate. The receptacle shall be recessed sufficiently within the box to allow the complete insertion of a standard cap, flush with the plate. A suitable clip or support for hanging the clock shall be secured to the top of the plate. Material and finish of the plate shall be as specified in paragraph DEVICE PLATES.

3.5.3 Weatherproof Applications

Weatherproof receptacles shall be suitable for the environment, damp or wet as applicable, and the housings shall be labeled to identify the allowable use. Receptacles shall be marked in accordance with UL 514A for the type of use indicated: "Damp locations", "Wet Locations", "Wet Location Only When Cover Closed". Assemblies shall be installed in accordance with the manufacturer's recommendations.

3.5.3.1 Damp Locations

Receptacles in damp locations shall be mounted in an outlet box with a gasketed, weatherproof, cast-metal cover plate (device plate, box cover) and a gasketed cap (hood, receptacle cover) over each receptacle opening. The cap shall be either a screw-on type permanently attached to the cover plate by a short length of bead chain or shall be a flap type attached to the cover with a spring loaded hinge.

3.5.3.2 Wet Locations

Receptacles in wet locations shall be installed in an assembly rated for such use whether the plug is inserted or withdrawn, unless otherwise indicated. In a duplex installation, the receptacle cover shall be configured to shield the connections whether one or both receptacles are in use.

3.5.4 Receptacles, 20-Ampere, 250-Volt

Receptacles, single, 20-ampere, 250-volt, shall be ivory molded plastic, two-pole, three-wire or three-pole, four-wire, grounding type complete with appropriate mating cord-grip plug.

3.5.5 Receptacles, 30-Ampere, 250-Volt

Receptacles, single, 30-ampere, 250-volt, shall be molded-plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.6 Receptacles, 50-Ampere, 125/250-Volt

Receptacles, single 50-ampere, 125/250-volt, shall be flush, molded plastic, three-pole, four-wire, grounding type. Each range receptacle shall be furnished with a nondetachable power supply cord for connection to the electric range. The cord shall be an angle-type 900 mm (36 inch) length of SRD range and dryer cable with one No. 8 and two No. 6 AWG conductors.

3.5.7 Receptacles, 50-Ampere, 250-Volt

Receptacles, single, 50-ampere, 250-volt, shall be flush molded plastic, three-pole, three-wire type, complete with appropriate mating cord-grip plug.

3.5.8 Special-Purpose or Heavy-Duty Receptacles

Special-purpose or heavy-duty receptacles shall be of the type and of ratings and number of poles indicated or required for the anticipated purpose. Contact surfaces may be either round or rectangular. One appropriate straight or angle-type plug shall be furnished with each receptacle. Locking type receptacles, rated 30 amperes or less, shall be locked by rotating the plug. Locking type receptacles, rated more than 50 amperes, shall utilize a locking ring.

3.6 WALL SWITCHES

Wall switches shall be of the totally enclosed tumbler type. The wall switch handle and switch plate color shall be ivory. Wiring terminals shall be of the screw type or of the solderless pressure type having suitable conductor-release arrangement. Not more than one switch shall be installed in a single-gang position. Switches shall be rated 20-ampere 120-volt for use on alternating current only. Pilot lights indicated shall consist of yoke-mounted candelabra-base sockets rated at 75 watts, 125 volts, and fitted with glass or plastic jewels. A clear 6-watt lamp shall be furnished and installed in each pilot switch. Jewels for use with switches controlling motors shall be green, and jewels for other purposes shall be red. Dimming switches shall be solid-state flush mounted, sized for the loads.

3.7 SERVICE EQUIPMENT

Service-disconnecting means shall be of the type indicated in paragraph POWER SWITCHGEAR ASSEMBLIES INCLUDING SWITCHBOARDS with an external handle for manual operation. When service disconnecting means is a part of an assembly, the assembly shall be listed as suitable for service entrance equipment. Enclosures shall be sheet metal with hinged cover for surface mounting unless otherwise indicated.

3.8 PANELBOARDS AND LOADCENTERS

Circuit breakers and switches used as a motor disconnecting means shall be capable of being locked in the open position. Door locks shall be keyed alike. Nameplates shall be as approved. Directories shall be typed to indicate loads served by each circuit and mounted in a holder behind a clear protective covering. Busses shall be copper. Wall mounted panelboards in unfinished rooms shall be surface mounted. Wall mounted panelboards in finished rooms shall be recessed.

3.8.1 Loadcenters

Loadcenters shall be circuit breaker equipped.

3.8.2 Panelboards

Panelboards shall be circuit breaker equipped.

3.9 FUSES

Equipment provided under this contract shall be provided with a complete set of properly rated fuses when the equipment manufacturer utilize fuses in the manufacture of the equipment, or if current-limiting fuses are required to be installed to limit the ampere-interrupting capacity of circuit breakers or equipment to less than the maximum available fault current at the location of the equipment to be installed. Fuses shall have a voltage rating of not less than the phase-to-phase circuit voltage, and shall have the time-current characteristics required for effective power system coordination. Time-delay and non-time-delay options shall be as specified.

3.9.1 Cartridge Fuses; Noncurrent-Limiting Type

Cartridge fuses of the noncurrent-limiting type shall be Class H, nonrenewable, dual element, time lag type and shall have interrupting capacity of 10,000 amperes. At 500 percent current, cartridge fuses shall not blow in less than 10 seconds.

3.9.2 Cartridge Fuses; Current-Limiting Type

Cartridge fuses, current-limiting type, Class RK1 shall have tested interrupting capacity not less than 200,000 amperes. Fuse holders shall be the type that will reject all Class H fuses.

3.9.3 Continuous Current Ratings (600 Amperes and Smaller)

Service entrance and feeder circuit fuses (600 amperes and smaller) shall be Class RK1 current-limiting, nontime-delay with 200,000 amperes interrupting capacity.

3.9.4 Continuous Current Ratings (Greater than 600 Amperes)

Service entrance and feeder circuit fuses (greater than 600 amperes) shall be Class L, current-limiting, nontime-delay with 200,000 amperes interrupting capacity.

3.9.5 Motor and Transformer Circuit Fuses

Motor, motor controller, transformer, and inductive circuit fuses shall be Class RK1 or RK5, current-limiting, time-delay with 200,000 amperes interrupting capacity.

3.10 UNDERGROUND SERVICE

Unless otherwise indicated, interior conduit systems shall be stubbed out 1.5 m beyond the building wall and 600 mm below finished grade, for interface with the exterior service lateral conduits and exterior communications conduits. Outside conduit ends shall be bushed when used for direct burial service lateral conductors. Outside conduit ends shall be capped or plugged until connected to exterior conduit systems. Underground service lateral conductors will be extended to building service entrance and terminated in accordance with the requirements of Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and NFPA 70.

3.11 MOTORS

Each motor shall conform to the kW (hp) and voltage ratings indicated, and shall have a service factor and other characteristics that are essential to the proper application and performance of the motors under conditions shown or specified. Three-phase motors for use on 3-phase 208-volt systems shall have a nameplate rating of 200 volts. Unless otherwise specified, all motors shall have open frames, and continuous-duty classification based on a 40 degree C ambient temperature reference. Polyphase motors shall be squirrel-cage type, having normal-starting-torque and low-starting-current characteristics, unless other characteristics are specified in other sections of these specifications or shown on contract drawings. The Contractor shall be responsible for selecting the actual kilowatt (horsepower) ratings and other motor requirements necessary for the applications indicated. When electrically driven equipment furnished under other sections of these specifications materially differs from the design, the Contractor shall make the necessary adjustments to the wiring, disconnect devices and branch-circuit protection to accommodate the equipment actually installed.

3.12 MOTOR CONTROL

Each motor or group of motors requiring a single control and not controlled from a motor-control center shall be provided under other sections of these specifications with a suitable controller and devices that will perform the functions as specified for the respective motors. Each motor of 93 W (1/8 hp) or larger shall be provided with thermal-overload protection. Polyphase motors shall have overload protection in each ungrounded conductor. The overload-protection device shall be provided either integral with the motor or controller, or shall be mounted in a separate enclosure. Unless otherwise specified, the protective device shall be of the manually reset type. Single or double pole tumbler switches specifically designed for alternating-current operation only may be used as manual controllers for single-phase motors having a current rating not in excess of 80 percent of the switch rating. Automatic control devices such as thermostats, float or pressure switches may control the starting and stopping of motors directly, provided the devices used are designed for that purpose and have an adequate kilowatt (horsepower) rating. When the automatic-control device does not have such a rating, a magnetic starter shall be used, with the automatic-control device actuating the pilot-control circuit. When combination manual and automatic control is specified and the automatic-control device operates the motor directly, a double-throw, three-position tumbler or rotary switch shall be provided for the manual control; when the automatic-control device actuates the pilot control circuit of a magnetic starter, the latter shall be provided with a three-position selector switch marked MANUAL-OFF-AUTOMATIC. Connections to the selector switch shall be such that only the normal automatic regulatory control devices will be bypassed when the switch is in the Manual position; all safety control devices, such as low- or high-pressure cutouts, high-temperature cutouts, and motor-overload protective devices, shall be connected in the motor-control circuit in both the Manual and the Automatic positions of the selector switch. Control circuit connections to any MANUAL-OFF-AUTOMATIC switch or to more than one automatic regulatory control device shall be made in accordance with wiring

diagram approved by the Contracting Officer unless such diagram is included on the drawings. All controls shall be 120 volts or less unless otherwise indicated.

3.12.1 Contacts

Unless otherwise indicated, contacts in miscellaneous control devices such as float switches, pressure switches, and auxiliary relays shall have current and voltage ratings in accordance with NEMA ICS 2 for rating designation B300.

3.12.2 Safety Controls

Safety controls for boilers shall be connected to a 2-wire, 120 volt grounded circuit supplied from the associated boiler-equipment circuit. Where the boiler circuit is more than 120 volts to ground, safety controls shall be energized through a two-winding transformer having its 120 volt secondary winding grounded. Overcurrent protection shall be provided in the ungrounded secondary conductor and shall be sized for the load encountered.

3.13 MOTOR-DISCONNECT MEANS

Each motor shall be provided with a disconnecting means when required by NFPA 70 even though not indicated. For single-phase motors, a single or double pole toggle switch, rated only for alternating current, will be acceptable for capacities less than 30 amperes, provided the ampere rating of the switch is at least 125 percent of the motor rating. Switches shall disconnect all ungrounded conductors.

3.15 LIGHTING FIXTURES, LAMPS AND BALLASTS

This paragraph shall cover the installation of lamps, lighting fixtures and ballasts in interior or building mounted applications.

3.15.1 Lamps

Lamps of the type, wattage, and voltage rating indicated shall be delivered to the project in the original cartons and installed just prior to project completion. Lamps installed and used for working light during construction shall be replaced prior to turnover to the Government if more than 15% of their rated life has been used. Lamps shall be tested for proper operation prior to turn-over and shall be replaced if necessary with new lamps from the original manufacturer. 10% spare lamps of each type, from the original manufacturer, shall be provided.

3.15.2 Lighting Fixtures

Fixtures shall be as shown and shall conform to the following specifications and shall be as detailed on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar designs and equivalent energy efficiency, light distribution and brightness characteristics, and of equal finish and quality will be acceptable if approved. In suspended acoustical ceilings with fluorescent fixtures, the fluorescent emergency light fixtures shall be furnished with self-contained battery packs.

3.15.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

3.15.2.2 Ceiling Fixtures

Ceiling fixtures shall be coordinated with and suitable for installation in, on or from the ceiling as shown. Installation and support of fixtures shall be in accordance with NFPA 70 and manufacturer's recommendations. Where seismic requirements are specified herein, fixtures shall be supported as shown or specified. Recessed fixtures shall have adjustable fittings to permit alignment with ceiling panels. Recessed fixtures installed in fire-resistive ceiling construction shall have the same fire rating as the ceiling or shall be provided with fireproofing boxes having materials of the same fire rating as the ceiling, in conformance with UL Elec Const Dir. Surface-mounted fixtures shall be suitable for fastening to the ceiling panel structural supports.

3.15.2.3 Fixtures for Installation in Grid Type Ceilings

Fixtures for installation in grid type ceilings which are smaller than a full tile shall be centered in the tile. 305 by 1219 mm fixtures shall be mounted along the grid rail as shown. Work above the ceiling shall be coordinated among the trades to provide the lighting layout shown. Fixtures mounted to the grid shall have trim exactly compatible with the grid. Contractor shall coordinate trims with ceiling trades prior to ordering fixtures. Metric fixtures shall be designed to fit the metric grid specified. Fixtures in continuous rows shall be coordinated between trades prior to ordering. Fixtures shall be mounted using independent supports capable of supporting the entire weight of the fixture. No fixture shall rest solely on the ceiling grid. Recessed fixtures installed in seismic areas should be installed utilizing specially designed seismic clips. Junction boxes shall be supported at four points.

3.15.2.4 Suspended Fixtures

Suspended fixtures shall be provided with swivel hangers or hand-straightens so that they hang plumb. Pendants, rods, or chains 1.2 meters or longer excluding fixture shall be braced to prevent swaying using three cables at 120 degrees of separation. Suspended fixtures in continuous rows shall have internal wireway systems for end to end wiring and shall be properly aligned to provide a straight and continuous row without bends, gaps, light leaks or filler pieces. Aligning splines shall be used on extruded aluminum fixtures to assure hairline joints. Steel fixtures shall be supported to prevent "oil-canning" effects. Fixture finishes shall be free of scratches, nicks, dents, and warps, and shall match the color and gloss specified. Pendants shall be finished to match fixtures. Aircraft cable shall be stainless steel. Canopies shall be finished to match the ceiling and shall be low profile unless otherwise shown. Maximum distance between suspension points shall be 3.1 meters or as recommended by the manufacturer, whichever is less.

Suspended fixtures installed in seismic areas shall have 45% swivel hangers and shall be located with no obstructions within the 45% range in all directions. The stem, canopy and fixture shall be capable of 45% swing.

3.15.3 Ballasts

Remote type ballasts or transformers, where indicated, shall be mounted in a well ventilated, easily accessible location, within the maximum operating distance from the lamp as designated by the manufacturer.

3.16 EMERGENCY LIGHTING, UNINTERRUPTIBLE POWER SYSTEM

Emergency power (UPS – Uninterrupted Power System) shall be provided by an AC System capable of powering a total connected load as indicated for a period of 1-1/2 hours. Utility input supply to the system to be as indicated. The UPS shall operate in a Double Conversion mode providing conditioned, isolated power or Maintenance Bypass mode providing isolated power to the emergency lighting loads. The system shall be capable of powering any combination of fluorescent ballasted lamps, incandescent lamps, electronic and high power factor compact fluorescent ballasts, H. I. D. lamps or other approved loads up to the total rating of the system.

3.16.1 Components

The system shall consist of a rectifier, charger, battery, inverter, protective devices, static transfer switch, synchronizing and phase lock circuitry, and controls required to provide regulated, uninterrupted, conditioned power to emergency lighting loads.

(a) System Charger: The system charger shall be the temperature compensated, constant voltage type providing constant current, float and equalize charging modes. The charger shall provide ample capacity to bring the system's battery bank from fully discharged to fully charged condition within acceptable UL 924 time standards.

(b) Rectifier: The rectifier shall have sufficient capacity to supply full load current to the inverter while recharging a fully discharged battery.

(c) Inverter: The inverter shall be an Insulated Gate Bipolar Transistor, Pulse Width Modulation design, capable of accepting the output of the boost and delivering AC power within specified limits to the critical load bus. The inverter shall be microprocessor controlled and shall include all necessary protective devices and control circuit. The inverter utilized by the system shall deliver single phase, sinusoidal emergency power free from high voltage surges or frequency drift. Inverter start up and shut down shall be accomplished by means of a highly reliable electro-mechanical relay capable of transferring 100 percent of the system's rated capacity to the connected emergency load within one second of utility failure. Inverter output regulation shall be held to +10 percent -5 percent variance from nominal. Output frequency tolerance shall be ± 2 percent. Full load harmonic distortion shall not exceed 10 percent. Inverter switching shall allow for the connection of normally-on, normally-off, or combination normally-on/normally-off, loads. Both charger and inverter assemblies shall employ fail-safe design and provide complete protection against thermal and current overloads. Inverter and charger operating efficiency shall not be less than 85 percent.

(d) Batteries: Emergency power source shall be provided by sealed maintenance-free lead-calcium recombination batteries with 10-year expected life.

(e) Static Transfer Switch: Static switch power rating shall be continuous duty power rated. Overload rating as shown: 10 minutes at 125%, 1 minute at 150%, 600 milliseconds at 1000%, and 100 milliseconds at 1500%. The static switch shall use naturally commutated high speed Silicon Controlled Rectifier rated to conduct full load current continuously while in either line interactive or double conversion mode. An internally mounted static transfer switch and bypass circuit shall be provided as an integral part of the UPS.

(f) System Protection: Automatic system protection circuits shall include a low voltage battery disconnect, a brownout protection circuit and a 15 minute time delay in retransfer to standby operation.

(g) Test Switch: A test switch shall be provided on the central display panel which will allow a manual 5 minute discharge/diagnostic test of the system at any time.

(h) Transfer Mechanism: Mechanism shall utilize electromechanical transfer relays.

(i) Miscellaneous Equipment:

If the battery is taken out of service for maintenance via the disconnect switch, the UPS continues to function but provides no backup protection. If the UPS is taken out of service for maintenance, the UPS shall be provided with an internal maintenance bypass switch to enable a load transfer to the bypass.

The following equipment shall be provided with the system:

AC Output Current Display
AC Input Current Display

3.17 EQUIPMENT CONNECTIONS

Wiring not furnished and installed under other sections of the specifications for the connection of electrical equipment as indicated on the drawings shall be furnished and installed under this section of the specifications. Connections shall comply with the applicable requirements of paragraph WIRING METHODS. Flexible conduits 2 m or less in length shall be provided to all electrical equipment subject to periodic removal, vibration, or movement and for all motors. All motors shall be provided with separate grounding conductors. Liquid-tight conduits shall be used in damp or wet locations.

3.17.1 Motors and Motor Control

Motors, motor controls, and motor control centers shall be installed in accordance with NFPA 70, the manufacturer's recommendations, and as indicated. Wiring shall be extended to motors, motor controls, and motor control centers and terminated.

3.17.2 Installation of Government-Furnished Equipment

Wiring shall be extended to the equipment and terminated.

3.18 CIRCUIT PROTECTIVE DEVICES

The Contractor shall calibrate, adjust, set and test each new adjustable circuit protective device to ensure that they will function properly prior to the initial energization of the new power system under actual operating conditions.

3.19 PAINTING AND FINISHING

Field-applied paint on exposed surfaces shall be provided under Section 09900 PAINTING, GENERAL.

3.20 REPAIR OF EXISTING WORK

The work shall be carefully laid out in advance, and where cutting, channeling, chasing, or drilling of floors, walls, partitions, ceiling, or other surfaces is necessary for the proper installation, support, or anchorage of the conduit, raceways, or other electrical work, this work shall be carefully done, and any damage to building, piping, or equipment shall be repaired by skilled mechanics of the trades involved at no additional cost to the Government.

3.21 FIELD TESTING

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 7 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and inspection recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results. All field test reports will be signed and dated by the Contractor.

3.21.1 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

3.21.2 Ground-Resistance Tests

The resistance of each grounding electrode system shall be measured using the fall-of-potential method defined in IEEE Std 81. Soil resistivity in the area of the grid shall be measured concurrently with the grid measurements. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

- a. Single rod electrode - 25 ohms.

3.21.3 Cable Tests

The Contractor shall be responsible for identifying all equipment and devices that could be damaged by application of the test voltage and ensuring that they have been properly disconnected prior to performing insulation resistance testing. An insulation resistance test shall be performed on all low and medium voltage cables after the cables are installed in their final configuration and prior to energization. The test voltage shall be 500 volts DC applied for one minute between each conductor and ground and between all possible combinations of conductors. The minimum value of resistance shall be:

$$R \text{ in megohms} = (\text{rated voltage in kV} + 1) \times 304.8 / (\text{length of cable in meters})$$

Each cable failing this test shall be repaired or replaced. The repaired cable system shall then be retested until failures have been eliminated.

3.21.3.1 Low Voltage Cable Tests

- a. Continuity test.
- b. Insulation resistance test.

3.21.4 Motor Tests

- a. Phase rotation test to ensure proper directions.
- b. Operation and sequence of reduced voltage starters.
- c. High potential test on each winding to ground.
- d. Insulation resistance of each winding to ground.
- e. Vibration test.
- f. Dielectric absorption test on motor and starter.

3.21.5 Dry-Type Transformer Tests

The following field tests shall be performed on all dry-type transformers

- a. Insulation resistance test phase-to-ground, each phase.
- b. Turns ratio test.

- c. Correct phase sequence

3.21.6 Circuit Breaker Tests

The following field tests shall be performed on circuit breakers.

3.21.6.1 Circuit Breakers, Low Voltage

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test
- d. Manual and electrical operation of the breaker.

3.21.6.2 Circuit Breakers, Molded Case

- a. Insulation resistance test phase-to-phase, all combinations.
- b. Insulation resistance test phase-to-ground, each phase.
- c. Closed breaker contact resistance test.
- d. Manual operation of the breaker.

3.22 OPERATING TESTS

After the installation is completed, and at such time as the Contracting Officer may direct, the Contractor shall conduct operating tests for approval. The equipment shall be demonstrated to operate in accordance with the specified requirements. An operating test report shall be submitted in accordance with paragraph FIELD TEST REPORTS.

3.23 FIELD SERVICE

3.23.1 Onsite Training

The Contractor shall conduct a training course for the operating staff as designated by the Contracting Officer. The training period shall consist of a total of 8 hours of normal working time and shall start after the system is functionally completed but prior to final acceptance tests. The course instruction shall cover pertinent points involved in operating, starting, stopping, servicing the equipment, as well as all major elements of the operation and maintenance manuals. Additionally, the course instructions shall demonstrate all routine maintenance operations. A VHS format video tape of the entire training shall be submitted.

3.24 ACCEPTANCE

Final acceptance of the facility will not be given until the Contractor has successfully completed all tests and after all defects in installation, material or operation have been corrected.

END OF SECTION

SECTION 16475

COORDINATED POWER SYSTEM PROTECTION

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C12.11	(1987; R 1993) Instrumental Transformers for Revenue Metering, 10 kV BIL Through 350 kV BIL (0.6 kV NSV Through 69 kV NSV)
ANSI C37.06	(1997) AC High-Voltage Circuit Breakers Rated on a Symmetrical Current Basis - Preferred Ratings and Related Required Capabilities for Switchgear
ANSI C37.16	(1997) Low-Voltage Power Circuit Breakers and AC Power Circuit Protectors - Preferred Ratings, Related Requirements, and Application Recommendations
ANSI C37.46	(1981; R 1992) Power Fuses and Fuse Disconnecting Switches
ANSI C37.50	(1989; R 1995) Switchgear Low-Voltage AC Power Circuit Breakers Used in Enclosures - Test Procedures

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2472	(1992) Sulfur Hexafluoride
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C37.2	(1996) Electrical Power System Device Function Numbers and Contract Designations
IEEE C37.04	(1979; R 1988; C37.04g; C37.04i) Rating Structure for AC High-Voltage circuit Breakers Rated on a Symmetrical Current Basis
IEEE C37.13	(1990; R 1995) Low-Voltage AC Power Circuit Breakers Used in Enclosures
IEEE C37.20.1	(1993) Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
IEEE C37.90	(1989; R 1994) Relays and Relay Systems Associated with Electric Power Apparatus

IEEE C57.13	(1993) Instrument Transformers
IEEE Std 242	(1986; R 1991) IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
IEEE Std 399	(1997) Recommended Practice for Industrial and Commercial Power Systems Analysis

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA AB 1	(1993) Molded Case Circuit Breakers and Molded Case Switches
NEMA FU 1	(1986) Low Voltage Cartridge Fuses
NEMA ICS 1	(1993) Industrial Controls and Systems
NEMA ICS 2	(1993) Industrial Control and Systems, Controllers, Contractors Overload Relays Rated not More Than 2,00 Volts AC or 750 Volts DC
NEMA ICS 3	(1993) Industrial Control and Systems Factory Built Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA SG 2	(1993) High Voltage Fuses
NEMA SG 3	(1995) Power Switching Equipment
NEMA SG 4	(1990) Alternating-Current High-Voltage Circuit Breakers
NEMA SG 5	(1995) Power Switchgear Assemblies

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 198B	(1995) Class H Fuses
UL 198C	(1986; Rev through Feb 1998) High-Interrupting-Capacity Fuses, Current-Limiting Types
UL 198D	(1995) Class K Fuses
UL 198E	(1988; Rev Jul 1988) Class R Fuses
UL 198H	(1988; Rev through Nov 1993) Class T Fuses
UL 486E	(1994; Rev Feb 1997) Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors

UL 489	(1996; Rev through Dec 1998) Molded-Case Circuit Breakers Molded-Case Switches, and Circuit-Breaker Enclosures
UL 508	(1993; Rev through Oct 1997) Industrial Control Equipment
UL 845	(1995; Rev Feb 1996) Motor Control Centers
UL 877	(1993; Rev through May 1997) Circuit Breakers and Circuit- Breaker Enclosures for Use in Hazardous (Classified) Locations

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330
SUBMITTAL PROCEDURES:

SD-03 Product Data

Fault Current Analysis; G
Protective Device Coordination Study; G

The study along with protective device equipment submittals. No time extensions or similar contact modifications will be granted for work arising out of the requirements for this study. Approval of protective devices proposed will be based on recommendations of this study. The Government shall not be held responsible for any changes to equipment, device ratings, settings, or additional labor for installation of equipment or devices ordered and/or procured prior to approval of the study.

Equipment;

Data consisting of manufacturer's time-current characteristic curves for individual protective devices, recommended settings of adjustable protective devices, and recommended ratings of non-adjustable protective devices.

System Coordinator; G

Verification of experience and license number, of a registered Professional Engineer with at least four years of current experience in the design of coordinated power system protection. Experience data shall include at least five references for work of a magnitude comparable to this contract, including points of contact, addresses and telephone numbers. This engineer must perform items required by this section to be performed by a registered Professional Engineer.

Protective Relays;

Data shall including calibration and testing procedures and instructions pertaining to the frequency of calibration, inspection, adjustment, cleaning, and lubrication.

Installation;

Procedures including diagrams, instructions, and precautions required to properly install, adjust, calibrate, and test the devices and equipment.

SD-06 Test Reports

Field Testing; G

The proposed test plan, prior to field tests. Plan shall consist of complete field test procedure including tests to be performed, test equipment required, and tolerance limits, including complete testing and verification of the ground fault protection equipment, where used. Performance test reports in booklet form showing all field tests performed to adjust each component and all field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Each test report shall indicate the final position of controls.

SD-07 Certificates

Devices and Equipment; G

Certificates certifying that all devices or equipment meet the requirements of the contract documents.

1.3 SYSTEM DESCRIPTION

The power system covered by this specification consists of the existing medium voltage system originating at the Sequelichew switchyard and continuing through construction to low voltage branch circuits in the building distribution systems.

1.4 QUALIFICATIONS

1.4.1 System Coordinator

System coordination, recommended ratings and settings of protective devices, and design analysis shall be accomplished by a registered professional electrical power engineer with a minimum of two years of current experience in the coordination of electrical power systems.

1.4.2 System Installer

Calibration, testing, adjustment, and placing into service of the protective devices shall be accomplished by a manufacturer's product field service engineer or independent testing company with a minimum of two years of current product experience in protective devices.

1.5 DELIVERY, STORAGE, AND HANDLING

Devices and equipment shall be visually inspected when received and prior to acceptance from conveyance. Stored items shall be protected from the environment in accordance with the manufacturer's published instructions. Damaged items shall be replaced.

1.6 PROJECT/SITE CONDITIONS

Devices and equipment furnished under this section shall be suitable for the following site conditions. Seismic details shall conform to Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT, 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT AND 16070 SEISMIC PROTECTION FOR ELECTRICAL EQUIPMENT.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Protective devices and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory utility type use for at least two years prior to bid opening.

2.2 COORDINATED POWER SYSTEM PROTECTION

Analyses shall be prepared to demonstrate that the equipment selected and system constructed meet the contract requirements for ratings, coordination, and protection. They shall include a load flow analysis, a fault current analysis, and a protective device coordination study. The studies shall be performed by a registered professional engineer with demonstrated experience in power system coordination in the last three years. The Contractor shall provide a list of references complete with points of contact, addresses and telephone numbers. The selection of the engineer is subject to the approval of the Contracting Officer.

2.14.1 Scope of Analyses

The fault current analysis, and protective device coordination study shall begin at: the source bus and extended through the secondary side of transformers for medium voltage distribution feeders.

2.14.2 Determination of Facts

The time-current characteristics, features, and nameplate data for each existing protective device shall be determined and documented. The Contractor shall coordinate with the Tacoma Power Utilities for fault current availability at the Sequelitchew substation

2.14.3 Single Line Diagram

A single line diagram shall be prepared to show the electrical system buses, devices, transformation points, and all sources of fault current (including generator and motor contributions). A fault-impedance diagram or a computer analysis diagram may be provided. Each bus, device or transformation point shall have a unique identifier. If a fault-impedance diagram is provided, impedance data shall be shown. Location of switches, breakers, and circuit interrupting devices shall be shown on the diagram together with available fault data, and the device interrupting rating.

2.14.4 Fault Current Analysis

2.14.4.1 Method

The fault current analysis shall be performed in accordance with methods described in IEEE Std 242, and IEEE Std 399.

2.14.4.2 Data

Actual data shall be utilized in fault calculations. Bus characteristics and transformer impedance shall be those proposed. Data shall be documented in the report.

2.14.4.3 Fault Current Availability

Balanced three-phase fault, bolted line-to-line fault, and line-to-ground fault current values shall be provided at each voltage transformation point and at each power distribution bus. The maximum and minimum values of fault available at each location shall be shown in tabular form on the diagram or in the report.

2.14.5 Coordination Study

The study shall demonstrate that the maximum possible degree of selectivity has been obtained between devices specified, consistent with protection of equipment and conductors from damage from overloads and fault conditions. The study shall include a description of the coordination of the protective devices in this project. A written narrative shall be provided describing: which devices may operate in the event of a fault at each bus; the logic used to arrive at device ratings and settings; situations where system coordination is not achievable due to device limitations (an analysis of any device curves which overlap); coordination between upstream and downstream devices; and relay settings. Recommendations to improve or enhance system reliability, and detail where such changes would involve additions or modifications to the contract and cost damages (addition or reduction) shall be provided. Composite coordination plots shall be provided on log-log graph paper.

2.14.6 Study report

- a. The report shall include a narrative describing: the analyses performed; the bases and methods used; and the desired method of coordinated protection of the power system.
- b. The study shall include descriptive and technical data for existing devices and new protective devices proposed. The data shall include manufacturers published data, nameplate data, and definition of the fixed or adjustable features of the existing or new protective devices.
- c. The report shall document utility company data including system voltages, fault MVA, system X/R ratio, time-current characteristic curves, current transformer ratios, and relay device numbers and settings; and existing power system data including time-current characteristic curves and protective device ratings and settings.
- d. The report shall contain fully coordinated composite time-current characteristics curves for each bus in the system, as required to ensure coordinated power system protection between protective devices or equipment. The report shall include recommended ratings and settings of all protective devices in tabulated form.
- e. The report shall provide the calculation performed for the analyses, including computer analysis programs utilized. The name of the software package, developer, and version number shall be provided.

PART 3 EXECUTION

3.1 VERIFICATION OF DIMENSIONS

After becoming familiar with details of the work, the Contractor shall verify dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work.

3.2 INSTALLATION

Protective devices shall be installed in accordance with the manufacturer's published instructions and in accordance with the requirements of NFPA 70 and IEEE C2.

3.3 FIELD TESTING

3.3.1 General

Field testing shall be performed in the presence of the Contracting Officer. The Contractor shall notify the Contracting Officer 30 days prior to conducting tests. The Contractor shall furnish all materials, labor, and equipment necessary to conduct field tests. The Contractor shall perform all tests and

inspections recommended by the manufacturer unless specifically waived by the Contracting Officer. The Contractor shall maintain a written record of all tests which includes date, test performed, personnel involved, devices tested, serial number and name of test equipment, and test results.

3.3.2 Safety

The Contractor shall provide and use safety devices such as rubber gloves, protective barriers, and danger signs to protect and warn personnel in the test vicinity. The Contractor shall replace any devices or equipment which are damaged due to improper test procedures or handling.

END OF SECTION

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SECTION 16528

EXTERIOR LIGHTING INCLUDING SECURITY AND CCTV APPLICATIONS

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO LTS-3 (1994) Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C78.1350 (1990) Electric Lamps - 400-Watt, 100-Volt, S51 Single-Ended High-Pressure Sodium Lamps

ANSI C78.1351 (1989) Electric Lamps - 250-Watt, 100-Volt S50 Single-Ended High-Pressure Sodium Lamps

ANSI C78.1352 (1990) Electric Lamps - 1000-Watt, 250-Volt, S52 Single-Ended High-Pressure Sodium Lamps

ANSI C78.1355 (1989) Electric Lamps - 150-Watt, 55-Volt S55 High-Pressure Sodium Lamps

ANSI C80.1 (1995) Rigid Steel Conduit - Zinc Coated

ANSI C82.4 (1992) Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps (Multiple-Supply Type)

ANSI C119.1 (1986; R 1997) Sealed Insulated Underground Connector Systems Rated 600 Volts

ANSI C135.1 (1979) Galvanized Steel Bolts and Nuts for Overhead Line Construction

ANSI C135.14 (1979) Staples with Rolled or Slash Points for Overhead Line Construction

ANSI C136.2 (1996) Luminaires, Voltage Classification Roadway Lighting Equipment

ANSI C136.3 (1995) Roadway Lighting Equipment-Luminaire Attachments

ANSI C136.6 (1997) Roadway Lighting Equipment - Metal Heads and Reflector Assemblies - Mechanical and Optical Interchangeability

ANSI C136.9	(1990) Roadway Lighting - Socket Support Assemblies for Use in Metal Heads - Mechanical Interchangeability
ANSI C136.10	(1996) Roadway Lighting- Locking-Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeability and Testing
ANSI C136.11	(1995) Multiple Sockets for Roadway Lighting Equipment
ANSI C136.15	(1986) Roadway Lighting, High-Intensity-Discharge and Low-Pressure Sodium Lamps in Luminaires -

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 36/A 36M	(1997a) Carbon Structural Steel
ASTM A 48	(1994a) Gray Iron Castings
ASTM A 123/A 123M	(1997a) Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153/A 153M	(1998) Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A 575	(1996) Steel Bars, Carbon, Merchant Quality, M-Grades
ASTM A 576	(1990b; R 1995) Steel Bars, Carbon, Hot-Wrought, Special Quality
ASTM B 2	(1994) Medium-Hard-Drawn Copper Wire
ASTM B 8	(1995) Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
ASTM B 117	(1997) Operating Salt Spray (Fog) Apparatus
ASTM C 478	(1997) Precast Reinforced Concrete Manhole Sections
ASTM D 1654	(1992) Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA (IESNA)

IESNA RP-8	(1983; R 1993) Roadway Lighting
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INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2	(2002) National Electrical Safety Code
IEEE C62.41	(1991; R 1995) Surge Voltages in Low-Voltage AC Power Circuits
IEEE C136.13	(1987; R 1997) Metal Brackets for Wood Poles
IEEE Std 81	(1983) Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(1991) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA ICS 1	(1993) Industrial Control and Systems
NEMA ICS 2	(1993) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2,000 Volts AC or 750 Volts DC Assemblies
NEMA ICS 6	(1993) Industrial Control and Systems, Enclosures
NEMA OS 1	(1996) Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports
NEMA OS 2	(1986; Errata Aug 1986; R 1991) Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports
NEMA RN 1	(1989) Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit
NEMA TC 6	(1990) PVC and ABS Plastic Utilities Duct for Underground Installation
NEMA TC 9	(1990) Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORIES (UL)

UL 6	(1997) Rigid Metal Conduit
UL 44	(1997; Rev Mar 1999) Rubber-Insulated Wires and Cables
UL 98	(1994; Rev through Jun 1998) Enclosed and Dead-Front Switches
UL 467	(1993; Rev Aug 1996) Grounding and Bonding Equipment
UL 486A	(1997; Rev through Dec 1998) Wire Connectors and Soldering Lugs for Use with Copper Conductors
UL 514A	(1996; R Jul 1998) Metallic Outlet Boxes
UL 514B	(1996; R Oct 1998) Fittings for Conduit and Outlet Boxes
UL 514C	(1996; R Sep 1998) Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers

UL 651	(1995; Rev through Oct 1998) Schedule 40 and 80 Rigid PVC Conduit
UL 651A	(1995; Rev through Apr 1998) Type EB and A Rigid PVC Conduit and HDPE Conduit
UL 854	(1996; Rev Apr 1998) Service-Entrance Cables
UL 1029	(1994; Rev through Dec 1997) High-Intensity-Discharge Lamp Ballasts
UL 1449	(1996; Rev through Oct 1998) Transient Voltage Surge Suppressors
UL 1572	(1995; Rev through Jun 1997) High Intensity Discharge Lighting Fixtures

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Lighting System; G,
Detail Drawings; G,

Detail drawings for the complete system and for poles, lighting fixtures, bracket arms, cable boxes, handholes, transformers, controllers and cameras. Detail drawings for precast handholes shall include a design analysis to determine that strength is equivalent to indicated cast-in-place concrete handholes. Drawings shall indicate bonding method for concrete encasement. Drawings shall include design calculations showing adequate strength of screw foundations. For CCTV lighting, data shall include:

- Infrared light call-up response time.
- Lamp strike and restrike times.
- System startup and shutdown operations.
- Manuals for CCTV Assessment Lighting equipment.
- A typical zone layout showing light locations, isolux patterns, and lighting ratios.

As-Built Drawings;

Final as-built drawings shall be finished drawings on mylar or vellum and shall be delivered with the final test report.

The contractor shall maintain a separate set of drawings, elementary diagrams and wiring diagrams of the lighting to be used for "as-built" drawings. This set shall be accurately kept up to date by the Contractor with all changes and additions to the lighting system. In addition to being complete and accurate, this set of drawings shall be kept neat and shall not be used for installation purposes. Upon completion of the as-built drawings, a

representative of the Government will review the as-built work with the Contractor. If the as-built work is not complete, the Contractor will be so advised and shall complete the work as required.

SD-03 Product Data

Equipment and Materials;

Data published by the manufacturer of each item on the list of equipment and material, to permit verification that the item proposed is of the correct size, properly rated or applied, or is otherwise suitable for the application and fully conforms to the requirements specified.

Spare Parts;

Spare parts data for each item of material and equipment specified, after approval of detail drawings for materials and equipment, and not later than 4 months before the date of beneficial occupancy. The data shall include a complete list of parts, special tools, and supplies, with current unit prices and sources of supply.

SD-06 Test Reports

CCTV Assessment Lighting; G,

Test procedures and reports for CCTV assessment lighting. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Operating Test; G,

Test procedures and reports for the Operating Test. After receipt by the Contractor of written approval of the test procedures, the Contractor shall schedule the tests. The final test procedures report shall be delivered after completion of the tests.

Ground Resistance Measurements;

The measured resistance to ground of each separate grounding installation, indicating the location of the rods, the resistance of the soil in ohms per millimeter and the soil conditions at the time the measurements were made. The information shall be in writing.

SD-10 Operation and Maintenance Data

Lighting System;

A draft copy of the operation and maintenance manuals, prior to beginning the tests for use during site testing. Final copies of the manuals as specified bound in hardback, loose-leaf binders, within 30 days after completing the field test. The draft copy used during site testing shall be updated with any changes required, prior to final delivery of the manuals. Each manual's contents shall be identified on the cover. The manual shall include names, addresses, and telephone numbers of each subcontractor installing equipment and systems, and nearest service representatives for each item of equipment for each system. The manuals shall have a table of contents and tab sheets. Tab sheets shall be placed at the beginning of each chapter or section and at the beginning of each appendix. The final copies delivered after completion of the field test shall include modifications made during installation checkout and acceptance.

1.3 SYSTEM DESCRIPTION

1.3.1 Lighting System

The lighting system shall be configured as specified and shown. The system shall include all fixtures, hardware, poles, cables, connectors, adapters and appurtenances needed to provide a fully functional lighting system.

1.3.2 Design Requirements for CCTV Assessment Lighting

The CCTV Assessment Lighting system shall be configured as specified and shown. Equipment shall conform to NFPA 70 and IEEE C2. The lighting configuration shall provide sufficient light for optimum CCTV assessment of each zone. The system shall include all fixtures, hardware, poles, cables, connectors, adapters, and appurtenances needed to provide a fully functional lighting system.

1.3.3 Electrical Requirements

The equipment shall operate from a voltage source as shown, plus or minus 10 percent, and 60 Hz, plus or minus 2 percent.

1.3.4 Power Line Surge Protection

Transient voltage surge suppressors shall be provided for all electronic equipment. Surge suppressors shall meet the requirements of IEEE C62.41, and be UL listed as having been tested in accordance with UL 1449. Surge suppressor ratings shall be 480/277 volts rms, operating voltage; 60 Hz; 3-phase; 4 wire with ground. Fuses shall not be used as surge suppression.

1.3.5 Interface Between CCTV Lighting and CCTV System

Infrared lights shall be interfaced to the CCTV system and shall provide automatic, alarm actuated call-up of the light associated with the alarm zone

1.3.6 Interface Between Lighting System and Power Distribution

Conductors shall include all conductors extending from the load side of the primary and secondary power panels that serve assessment lighting equipment and be as indicated.

1.3.7 Nameplates

Each major component of equipment shall have a nonferrous metal or engraved plastic nameplate which shall show, as a minimum, the manufacturer's name and address, the catalog or style number, the electrical rating in volts, and the capacity in amperes or watts.

1.3.8 Standard Products

Materials and equipment shall be standard products of manufacturer regularly engaged in the manufacture of such products. Items of equipment shall essentially duplicate equipment that has been in satisfactory use at least 2 years prior to bid opening.

1.3.9 Protection of Security Lighting System Components

1.3.9.1 Components and Conductors

Security lighting system conductors shall be protected from damage. Lighting system conductors shall be installed in raceways, conduits or by means of direct burial, as shown. Where the conductors leave the underground systems, the conductors shall be in rigid steel conduit of the indicated size. Wire

guards shall be provided to protect security lighting luminaries mounted below 6.1 m. A NEMA ICS 6, Type 4 enclosure shall house exterior group-located electrical equipment such as time switches, safety switches, and magnetic contactors. Where only one piece of equipment is being provided at a location, the equipment shall be provided with its own enclosure.

1.3.9.2 Tamper Provisions

Enclosures, cabinets, housings (other than luminaire housings), boxes, raceways, conduits, and fittings having hinged doors or removable covers, and which contain any part of the security lighting system (including power sources), shall be provided with corrosion-resistant tamper switches, connected to an Intrusion Detection System (IDS), that will initiate an alarm signal when the door or cover is opened or moved. Tamper switches shall be inaccessible until the switch is activated. Switch leads and mounting hardware shall be concealed from the exterior of the enclosure. For pull or junction boxes which contain no splices or connections the covers may be protected by 6.4 mm (1/4 inch) tack welds on four sides of each cover rather than by tamper switches. Labels shall be affixed to indicate they contain no connections. Labels shall not indicate that the box is part of the security system.

1.4 CORROSION PROTECTION

1.4.1 Aluminum Materials

Aluminum shall not be used.

1.4.2 Ferrous Metal Materials

1.4.2.1 Hardware

Ferrous metal hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M and ASTM A 123/A 123M.

1.4.2.2 Equipment

Equipment and component items, including but not limited to metal poles and ferrous metal luminaires not hot-dip galvanized or porcelain enamel finished, shall be provided with corrosion-resistant finishes which shall withstand 480 hours of exposure to the salt spray test specified in ASTM B 117 without loss of paint or release of adhesion of the paint primer coat to the metal surface in excess of 1.6 mm (1/16 inch) from the test mark. The scribed test mark and test evaluation shall have a rating of not less than 7 in accordance with TABLE 1, (procedure A) of ASTM D 1654. Cut edges or otherwise damaged surfaces of hot-dip galvanized sheet steel or mill galvanized sheet steel shall be coated with a zinc rich paint conforming to the manufacturer's standard.

1.4.3 Finishing

Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory, shall be as specified in Section 09900 PAINTING, GENERAL.

PART 2 PRODUCTS

2.1 STANDARD PRODUCT

Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening. Items of the same classification shall be identical including equipment, assemblies, parts, and components.

2.2 BRACKET ARMS

2.2.1 On Aluminum, Steel, Fiberglass, and Concrete Poles

Poles shall be provided with bracket arms of the style and of the length indicated on drawings. Bracket arms shall conform to the design of the pole provided. The bracket arms shall be capable of supporting the equipment to be mounted on it with the maximum wind and ice loading encountered at the site. Strength of bracket arms shall be in accordance with IEEE C136.13. Steel brackets shall be galvanized. Wood bracket arms shall not be used.

2.2.2 Floodlight Brackets

Floodlight brackets shall be coordinated with the floodlight support provided.

2.3 CABLE

The Contractor shall provide all wire and cable not indicated as government furnished equipment. Wire and cable components shall be able to withstand the jobsite environment for a minimum of 20 years.

2.3.1 Insulated Cable

Cable shall be type USE conforming to UL 854, with copper conductors and type RHW or XHHW insulation conforming to UL 44, and shall include green ground conductor. Cable shall be provided with insulation of a thickness not less than that given in column A of TABLE 15.1 of UL 854. Cable shall be rated 600 volts. Parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded.

2.3.2 Bare Copper Conductors

Medium-hard-drawn copper conductors shall conform to ASTM B 2 and ASTM B 8.

2.4 CABLE SPLICES AND CONNECTORS

Cable splices and connectors shall conform to UL 486A. Underground splices and connectors shall also conform to the requirements of ANSI C119.1.

2.5 CABLE BOXES

Boxes and covers shall be made of cast iron with zinc coated finish, and shall be of the sizes indicated on drawings. The minimum inside dimensions shall be not less than 304.8 mm (12 inches) square by 152.4 mm (6 inches) deep and not less than required to house the cable splice. A suitable gasket shall be installed between the box and cover for watertightness. A sufficient number of screws shall be installed to hold the cover in place along the entire surface of contact. Grounding lugs shall be provided.

2.6 MANHOLES, HANDHOLES, AND PULLBOXES

Manholes, handholes, and pullboxes shall be as indicated. Strength of manholes, handholes, and pullboxes and their frames and covers shall conform to the requirements of IEEE C2. Precast concrete manholes shall have the required strength established by ASTM C 478. Frames and covers for manholes shall be made of gray cast iron. A machine-finished seat shall be provided to ensure a matching joint between frame and cover. Cast iron shall comply with ASTM A 48, Class 30B, minimum. Handholes for low voltage cables installed in parking lots, sidewalks, and turfed areas shall be from an aggregate consisting of sand and with continuous woven glass strands having an overall compressive strength of at least 69 MPa and a flexural strength of at least 34.5 MPa. Pullbox and

handhole covers in parking lots, sidewalks, and turfed areas shall be of the same material as the box. Concrete pullboxes shall consist of precast reinforced concrete boxes, extensions, bases, and covers. A sufficient number of tamperproof bolts shall be installed to hold the cover firmly in place along the entire surface of contact; a tool for the tamperproof bolts shall be furnished.

2.7 CONDUIT, DUCTS AND FITTINGS

2.7.1 Conduit, Rigid Steel

Rigid steel conduit shall conform to ANSI C80.1 and UL 6.

2.7.2 Conduit Coatings

Underground metallic conduit and fittings shall be coated with a plastic resin system conforming to NEMA RN 1, Type 40. Epoxy systems may also be used.

2.7.3 Conduit Fittings and Outlets

2.7.3.1 Boxes, Metallic Outlets

NEMA OS 1 and UL 514A.

2.7.3.2 Boxes, Nonmetallic, Outlet and Flush-Device Boxes and Covers

NEMA OS 2 and UL 514C.

2.7.3.3 Boxes, Switch (Enclosed), Surface Mounted

UL 98.

2.7.3.4 Fittings for Conduit and Outlet Boxes

UL 514B.

2.7.3.5 Fittings, PVC, for Use with Rigid PVC Conduit and Tubing

UL 514B.

2.7.4 Non-Metallic Duct

Non-metallic duct lines and fittings utilized for underground installation shall be suitable for the application. Duct shall be thick-wall, single, round-bore type. Material of one type shall be used. Acrylonitrile-butadiene-styrene (ABS) duct shall conform to NEMA TC 6 and NEMA TC 9. High-density conduit shall conform to UL 651A. Schedule 40 polyvinyl chloride (PVC) shall conform to UL 651. Plastic utility duct and fittings manufactured without a UL label or listing shall be provided with a certification as follows: "The materials are suitable for use with 75 degree C (167 degrees F) wiring. No reduction of properties in excess of that specified for materials with a UL label or listing will be experienced if samples of the finished product are operated continuously under the normal conditions that produce the highest temperature in the duct."

2.8 GROUND RODS

Ground rods shall be of copper clad steel conforming to UL 467 not less than 19.1 mm (3/4 inch) in diameter by 3.1 m (10 feet) in length of the sectional type driven full length into earth.

2.9 POLES

Metal and concrete poles shall be the pole manufacturer's standard design for supporting the number of fixtures indicated. Poles shall be designed for a wind velocity of 35.8 meters per second (80 mph) at the base of the pole, for a wind gust factor of 1.3, and for the height and drag factors recommended by AASHTO LTS-3. The effective projected area of luminaires and other pole-mounted devices shall be taken into account in pole design. Poles shall have grounding provisions. The type of pole shaft material provided shall not be mixed on any project. Grounding connection shall be provided near the bottom of each metal pole and at each concrete pole anchor base. Scratched, stained, chipped, or dented poles shall not be installed.

2.9.1 Aluminum Poles

Aluminum poles and brackets for walkway lighting shall have a dark anodic bronze finish to match fixtures and shall not be painted. Manufacturer's standard provision shall be made for protecting the finish during shipment and installation. Minimum protection shall consist of spirally wrapping each pole shaft with protective paper secured with tape, and shipping small parts in boxes.

- a. Shafts shall be round and of seamless construction. The wall thickness shall be at least 4.8 mm (0.188 in). Exterior surfaces shall be free of protuberances, dents, cracks, and discoloration. Material for shafts shall be 6063 aluminum alloy; after fabrication, the alloy shall have a T6 temper. Tops of shafts shall be fitted with a round or tapered cover. Bases shall be anchor bolt mounted, made of cast aluminum alloy 356-T6, and shall be machined to receive the lower end of shafts. Joints between shafts and bases shall be welded. Bases shall be provided with four holes, spaced 90 degrees apart, for anchorage.
- b. Hardware, except anchor bolts, shall be either 2024-T4 anodized aluminum alloy or stainless steel.

2.9.2 Steel Poles

Steel poles shall be hot-dip galvanized in accordance with ASTM A 123/A 123M and shall not be painted. Poles shall have tapered tubular members, either round in cross-section or polygonal. Pole shafts shall be one piece. Poles shall be welded construction with no bolts, rivets, or other means of fastening except as specifically approved. Pole markings shall be approximately 900 to 1270 mm above grade and shall include manufacturer, year of manufacture, top and bottom diameters, length, and a loading tree. Attachment requirements shall be provided as indicated, including grounding provisions. Climbing facilities are not required. Bases shall be of the anchor bolt-mounted type.

2.9.3 Concrete Poles

Concrete poles shall be designed to withstand the loads specified in IEEE C2 multiplied by the appropriate overload capacity factors. Poles shall be reinforced or prestressed, either cast or spun. Spun poles shall be manufactured by a centrifugal spinning process with concrete pumped into a polished round tapered metal mold. Concrete for spun poles shall have a compressive strength of at least 34.5 MPa (5,000 psi) at 28 days; steel wire shall have an ultimate tensile strength of at least 827 MPa (120,000 psi); and reinforcing bars shall have an ultimate tensile strength of at least 276 MPa (40,000 psi). After the high speed spinning action is completed, a spun pole shall be cured by a suitable wet steam process. Spun poles shall have a water absorption of not greater than 3 percent to eliminate cracking and to prevent erosion. Concrete poles shall have hollow shafts. Poles shall have a hard, smooth, nonporous surface that is resistant to soil acids, road salts, and attacks of water and frost. Poles shall not be installed for at least 15 days after manufacture. Fittings and brackets that conform to the concrete pole design shall be provided. Poles shall conform to strength calculations performed by a registered professional engineer and submitted in accordance with detail drawings portion of paragraph SUBMITTALS.

2.9.4 Anchor Bolts

Anchor bolts shall be the pole manufacturer's standard, but not less than necessary to meet the pole wind and ice loading, herein and other specified design requirements.

2.10 POLE LINE HARDWARE

Zinc coated hardware shall conform to ANSI C135.1 and ANSI C135.14, and steel hardware material shall conform to ASTM A 575 and ASTM A 576. Hardware shall be hot-dip galvanized in accordance with ASTM A 153/A 153M.

2.11 SERIES ROADWAY LIGHTING INSULATORS

Pin insulators shall be Class 55-5. Line-post insulators shall be Class 57-1 or 57-11.

2.12 ELECTRICAL ENCLOSURES

The Contractor shall provide metallic enclosures as needed to house the security and CCTV lighting equipment. Enclosures shall conform to NEMA ICS 6 and NEMA 250. Enclosures shall be provided with lockable or padlock handles. Keys for lockable enclosures shall be delivered to the Contracting Officer. The enclosures shall be as specified or as shown on the drawings.

2.12.1 Exposed-to-Weather Enclosures

Enclosures to house lighting equipment in an outdoor environment shall meet the requirements of a NEMA 4 enclosure as defined in NEMA 250.

2.13 ILLUMINATION

2.13.1 General Lighting

Luminaires, ballasts, lamps, and control devices required for general area Security lighting, and parking area lighting, including floodlighting shall be in accordance with the drawings.

2.13.2 Roadway Lighting

Luminaires, ballasts, lamps, and control devices required for roadway lighting shall be in accordance with the drawings.

2.14 LAMPS AND BALLASTS, HIGH INTENSITY DISCHARGE (HID) SOURCES

2.14.1 High-Pressure Sodium

Lamps shall conform to ANSI C78.1350 or ANSI C78.1351 or ANSI C78.1352 or ANSI C78.1355. Ballasts shall conform to ANSI C82.4, or UL 1029. High-pressure sodium lamps shall be clear.

2.15 LUMINAIRE COMPONENTS

Luminaire components shall conform to the following: attachments, ANSI C136.3; voltage classification, ANSI C136.2; field identification marking, ANSI C136.15; interchangeability, ANSI C136.6 and ANSI C136.9; and sockets, ANSI C136.11.

2.16 LIGHTING CONTROL EQUIPMENT

2.16.1 Photo-Control Devices

Photo-control devices shall conform to ANSI C136.10. Each photo-control element shall be a replaceable, weatherproof, plug-in or twist-lock assembly adjustable operation range of approximately 5.4 to 53.8 lux. Luminaires shall be equipped with weatherproof plug-in or twist-lock receptacle to receive the photo-control element.

2.16.2 Manual Control Switches

Manual control switches shall conform to UL 98. The switches shall be the heavy-duty type and shall be suitable for operation on a 120 volt, 60 Hz system. The number of poles and ampere rating shall be as indicated. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. The selector switch shall have a minimum of three positions: ON, OFF, and AUTOMATIC. The automatic selection shall be used when photoelectric or timer control is desired. The selector switch shall interface with the lighting system magnetic contactor and control its activity.

2.16.3 Safety Switches

Switches shall be the heavy-duty type with NEMA ICS 6 Type 4 enclosures and shall be suitable for operation on a 480Y/277 volt, 60 Hz, three-phase system. Switch construction shall be such that a screwdriver will be required to open the switch door when the switch is on. Blades shall be visible with door open and shall be of the quick-make, quick-break type. Terminal lugs shall be coordinated with the wire size. Switches shall conform to UL 98.

2.16.4 Magnetic Contactor

Magnetic contactors shall be mechanically held, electrically operated, and shall conform to NEMA ICS 1 and NEMA ICS 2. The contactor shall be suitable for 277 volts, single phase, 60 Hz. Coil voltage shall be 277 volts. Maximum continuous ampere rating and number of poles shall be as indicated on drawings. Enclosures for contactors mounted indoors shall be NEMA ICS 6, Type 1. Each contactor shall be provided with a spare, normally open auxiliary contact. Terminal lugs shall be coordinated with the wire size.

2.17 PHOTOMETRIC DISTRIBUTION CLASSIFICATION

Photometrics shall conform to IESNA RP-8.

2.18 LUMINAIRES, FLOODLIGHTING

2.18.1 HID and Incandescent

HID lighting fixtures shall conform to UL 1572.

2.19 FIXTURES

Standard fixtures shall be as detailed on the drawings. Special fixtures shall be as indicated on the drawings. Illustrations shown on the drawings are indicative of the general type desired and are not intended to restrict selection to fixtures of any particular manufacturer. Fixtures of similar design, equivalent light distribution and brightness characteristics, equal finish and quality will be acceptable as approved.

2.19.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be provided for proper installation.

2.19.2 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special Type 1.

PART 3 EXECUTION

3.1 GENERAL

The Contractor shall install all system components, including government furnished equipment, and appurtenances in accordance with the manufacturer's instructions, IEEE C2, and contract documents, and shall furnish necessary hardware, fixtures, cables, wire, connectors, interconnections, services, and adjustments required for a complete and operable system.

3.1.1 Current Site Conditions

The Contractor shall verify that site conditions are in agreement with the design package. The Contractor shall report all changes to the site or conditions that will affect performance of the system to the Government. The Contractor shall not take any corrective action without written permission from the Government.

3.1.2 Existing Equipment

The Contractor shall connect to and utilize existing lighting equipment and devices as shown. Lighting equipment that is usable in their original configuration without modification may be reused with Government approval. The Contractor shall perform a field survey, including testing and inspection of existing lighting equipment and control lines intended to be incorporated into the lighting system, and furnish a report to the Government. For those items considered nonfunctioning, specification sheets, or written functional requirements to support the findings and the estimated cost to correct the deficiency shall be provided with the report. As part of the report, the Contractor shall include the scheduled need date for connection to all existing equipment. The Contractor shall make written requests and obtain approval prior to disconnecting any control lines and equipment, and creating equipment downtime. Such work shall proceed only after receiving Government approval of these requests. If any device fails after the Contractor has commenced work on that device, the Contractor shall diagnose the failure and perform any necessary corrections to the equipment. The Government is responsible for maintenance and repair of Government equipment. The Contractor shall be held responsible for repair costs due to Contractor negligence or abuse of Government equipment.

3.2 ENCLOSURE PENETRATIONS

Enclosure penetrations shall be from the bottom unless the system design requires penetrations from other directions. Penetrations of interior enclosures involving transitions of conduit from interior to exterior, and penetrations on exterior enclosures shall be sealed with rubber silicone sealant to preclude the entry of water. The conduit riser shall terminate in a hot-dipped galvanized metal cable terminator. The terminator shall be filled with an approved sealant as recommended by the cable manufacturer, and in such a manner that the cable is not damaged.

3.3 PREVENTION OF CORROSION

3.3.1 Aluminum

Aluminum shall not be used in contact with earth or concrete, and where connected to dissimilar metal, shall be protected by approved fittings and treatment.

3.3.2 Steel Conduits

Steel conduits shall not be installed within concrete slabs-on-grade. Steel conduits installed underground or under slabs-on-grade, or penetrating slabs-on-grade, shall be field wrapped with 254 micrometers (0.010 inch) thick pipe-wrapping plastic tape applied with a 50 percent overlap, or shall have a factory-applied plastic resin, epoxy coating. Zinc coating may be omitted from steel conduit which has a factory-applied epoxy coating.

3.3.3 Cold Galvanizing

Field welds and/or brazing on factory galvanized boxes, enclosures, conduits, etc. shall be coated with a cold galvanized paint containing at least 95 percent zinc by weight.

3.4 CABLE INSTALLATION

Cable and all parts of the cable system such as splices and terminations shall be rated not less than 600 volts. The size and number of conductors and the number of cables shall be as indicated. Conductors larger than No. 8 AWG shall be stranded. Each circuit shall be identified by means of fiber or nonferrous metal tags, or approved equal, in each handhole and junction box, and at each terminal.

3.4.1 Splices

Splices below grade shall be made with nonpressure-filled resin systems using transparent, interlocking, self-venting, longitudinally split plastic molds. Splices above grade shall be made with sealed insulated pressure connectors and shall provide insulation and jacket equal to that of the cable. In order to prevent moisture from entering the splice, jackets shall be cut back to expose the required length of insulation between the jacket and the tapered end of the insulation.

3.4.2 Installation in Duct Lines

Ground conductors shall be installed in duct with the associated phase conductors. Cable splices shall be made in handholes only.

3.5 CAMERA INSTALLATION

The video camera shall conform to **EIA 170** and **EIA ANSI/EIA-330** specifications. All electronic components and circuits shall be solid state. Signal-to-noise ratio shall not be less than 42 dB unweighted. The camera shall exhibit no geometric distortion. The lens mount shall be a C-mount, and the camera shall have a back focus adjustment. The camera shall operate from **minus 10.0 degrees C to plus 55 degrees C (14 to 131 degrees F)** **14 to 131 degrees F** without auxiliary heating or cooling, and with no change in picture quality or resolution. The camera shall operate on 60 Hz AC power, and shall be capable of operating at a voltage of 205 to 240 Volts. Cameras shall be mounted on poles.

3.6 DUCT LINES

3.6.1 Requirements

Numbers and size of ducts shall be as indicated. Duct lines shall be laid with a minimum slope of 100 mm per 30 m. Depending on the contour of the finished grade, the high point may be at a terminal, a manhole, a handhole, or between manholes or handholes. Short radius manufactured 90 degree duct bends may be used only for pole or equipment risers, unless specifically indicated as acceptable. The minimum manufactured bend radius shall be 450 mm (18 inches) for ducts of less than 80 mm (3 inches) in diameter, and 900 mm (36 inches) for duct 80 mm (3 inches) or greater in diameter. Otherwise, long sweep bends having a minimum radius of 7.6 m (25 feet) shall be used for a change of direction of more than 5 degrees, either horizontally or vertically. Both curved and straight sections may be used to form long sweep bends, but the maximum curve used shall be 30 degrees and manufactured bends shall be used. Ducts shall be provided with end bells when duct lines terminate in manholes or handholes.

3.6.2 Treatment

Ducts shall be kept clean of concrete, dirt, or foreign substances during construction. Field cuts requiring tapers shall be made with proper tools and shall match factory tapers. A coupling recommended by the duct manufacturer shall be used when an existing duct is connected to a duct of different material or shape. Ducts shall be stored to avoid warping and deterioration with ends sufficiently plugged to prevent entry of any water or solid substances. Ducts shall be thoroughly cleaned before being laid. Plastic ducts shall be stored on a flat surface and protected from the direct rays of the sun.

3.6.3 Concrete Encasement

Ducts requiring concrete encasements shall comply with NFPA 70 except that electrical duct bank configurations for ducts 150 mm (6 inches) in diameter shall be determined by calculation and as shown on the drawings. Duct line encasements shall be monolithic construction. Where a connection is made to a previously poured encasement, the new encasement shall be well bonded or doweled to the existing encasement. At any point, except railroad and airfield crossings, tops of concrete encasements shall not be less than the cover requirements listed in NFPA 70. Where ducts are jacked under existing pavement, rigid steel conduit shall be installed. To protect the corrosion-resistant conduit coating, predrilling or installing conduit inside a larger iron pipe sleeve (jack-and-sleeve) is required. Separators or spacing blocks shall be made of steel, concrete, plastic, or a combination of these materials placed not more than 1.2 m on centers. Ducts shall be securely anchored to prevent movement during the placement of concrete, and joints shall be staggered at least 150 mm vertically.

3.6.4 Installation of Couplings

Joints in each type of duct shall be made up in accordance with the manufacturer's recommendation for the particular type of duct and coupling selected and as approved.

3.6.4.1 Plastic Duct

Duct joints shall be made by brushing a plastic solvent on insides of plastic coupling fittings and on outsides of duct ends. Each duct and fitting shall then be slipped together with a quick 1/4 turn to set the joint tightly.

3.6.5 Concrete

Concrete work shall be as specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be plain, 17 MPa (2500 psi) at 28 days, except that reinforced concrete shall be 21 MPa (3000 psi) at 28 days. Duct line encasement shall be of monolithic construction. Where a connection

is made to an existing duct line, the concrete encasement shall be well bonded or doweled to the existing encasement.

3.6.6 Duct Line Markers

Duct line markers shall be provided at the ends of long duct line stubouts or for other duct locations that are indeterminate because of duct curvature or terminations at completely below-grade structures. In addition to markers, a 0.127 mm (5 mil) brightly colored plastic tape, not less than 75 mm (3 inches) in width and suitably inscribed at not more than 3 m (10 feet) on centers with a continuous metallic backing and a corrosion-resistant 0.0254 mm (1 mil) metallic foil core to permit easy location of the duct line, shall be placed approximately 300 mm below finished grade levels of such lines.

3.7 HANDHOLES

The exact locations shall be determined after carefully considering the locations of other utilities, grading, and paving. Exact locations shall be approved before construction is started.

3.7.1 Construction

Handholes shall be constructed as indicated on drawings, including appurtenances. Top, walls, and bottom shall consist of reinforced concrete. Walls and bottom shall be of monolithic construction. Concrete shall be 21 MPa at 28 days. Precast concrete handholes having the same strength and inside dimensions as cast-in-place concrete handholes may be used. In paved areas, the top of entrance covers shall be flush with the finished surface of the paving. In unpaved areas, the top of entrance covers shall be approximately 15 mm above the finished grade. Where finished grades are in cut areas, unmortared brick shall be installed between the top of handhole and entrance frame to temporarily elevate the entrance cover to existing grade level. Where duct lines enter walls, the sections of duct may be cast in the concrete or may enter the wall through a suitable opening. The openings around entering duct lines shall be caulked tight with lead wool or other approved material.

3.7.2 Appurtenances

The following appurtenances shall be provided for each handhole.

3.7.3 Cable Pulling-In Irons

A cable pulling-in iron shall be installed in the wall opposite each duct line entrance.

3.7.4 Ground Rods

In each handhole, at a convenient point close to the wall, a ground rod conforming to paragraph GROUNDING shall be driven into the earth before the floor is poured; approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor; a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall.

3.8 POLE INSTALLATION

Pole lengths shall provide a luminaire mounting height of 9.1 m (30 feet). Luminaire mounting height may be increased by the height of the transformer base where required. Electrical cabling shall be provided to the light pole as specified. The mount interfaces shall have ac power connected, and the pole wiring harness shall be connected to the luminaire. Light poles shall not be installed outside the site or inside the perimeter zone. Security system light poles shall be installed inside the secure area. Pole installation shall conform to the manufacturer's recommendations, NFPA 70, and IEEE C2. Poles shall be set straight and plumb.

3.8.1 Pole Brackets

Brackets shall be installed as specified by the manufacturer and as shown on drawings. Mounting hardware shall be sized appropriately to secure the mount, luminaire, and housing with wind and ice loading normally encountered at the site. Pole brackets for floodlights shall have the number of tenons indicated, arranged to provide the indicated spread between each tenon. Where indicated on drawings, adjustable heads shall be installed on the brackets to position the luminaires. Identical brackets shall be used with one type of luminaire.

3.8.2 Concrete Foundations

Concrete foundations shall have anchor bolts accurately set in the foundation using a template supplied by the pole manufacturer. Once the concrete has cured, the pole shall be set on the foundation, leveled on the foundation bolts, and secured with the holding nuts. The space between the foundation and the pole base shall be grouted. Concrete and grout work shall conform to Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. Concrete shall be 21 MPa (3000 psi) at 28 days.

3.8.3 Rigid Steel Conduit Ells

Rigid steel conduit ells shall be provided at all poles. Rigid steel conduit shall be connected to the ells and shall extend to a minimum height of 3 m above grade. Rigid steel conduit ells shall be provided for wood poles, where required

3.8.4 Aluminum, Steel, and Concrete Pole Installation

Poles shall be mounted on cast-in-place or power-installed screw foundations. Concrete poles shall be embedded in accordance with the details shown. Conduit elbows shall be provided for cable entrances into pole interiors.

3.8.4.1 Cast-In-Place Foundations

Concrete foundations, sized as indicated, shall have anchor bolts accurately set in foundations using templates supplied by the pole manufacturer. Concrete work and grouting is specified in Section 03300 CAST-IN-PLACE STRUCTURAL CONCRETE. After the concrete has cured, pole anchor bases shall be set on foundations and leveled by shimming between anchor bases and foundations or by setting anchor bases on leveling nuts and grouting. Poles shall be set plumb. Anchor bolts shall be the manufacturer's standard, and not less than necessary to meet the pole wind loading and other specified design requirements.

3.8.4.2 Power-Installed Screw Foundations

Power-installed screw foundations having the required strength mounting bolt and top plate dimensions may be utilized. Screw foundations shall be of at least 6.4 mm (1/4 inch) thick structural steel conforming to ASTM A 36/A 36M and hot-dip galvanized in accordance with ASTM A 123/A 123M. Conduit slots in screw foundation shafts and top plates shall be marked to indicate orientation. Design calculations indicating adequate strength shall be approved before installation of any screw foundation.

3.9 LIGHTING

3.9.1 Lamps

Lamps of the proper type, wattage, and voltage rating shall be delivered to the project in the original containers and installed in the fixtures just before completion of the project.

3.9.2 Fixture Installation

Standard fixtures shall be installed as detailed on the drawings. Special fixtures shall be as indicated on drawings. Illustrations shown on these sheets or on the drawings are indicative of the general type desired and are not intended to restrict selection of fixtures to any particular manufacturer. Fixtures of similar design, equivalent light-distribution and brightness characteristics, and equal finish and quality will be acceptable as approved.

3.9.2.1 Accessories

Accessories such as straps, mounting plates, nipples, or brackets shall be installed as required for proper installation.

3.9.2.2 In-Line Fuses

An in-line fuse shall be provided for each fixture.

3.9.2.3 Special Fixtures

The types of special fixtures are designated by letters and numbers. For example, SP-1 denotes special type 1.

3.10 LIGHTING CONTROL SYSTEM

3.10.1 Photo-Control

Lighting luminaires shall be controlled in banks by a single photo-control element mounted within each bank.

3.10.2 Manual and Safety Switches

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.10.3 Magnetic Contactors

Terminal lugs shall be coordinated with the wire size. Switches shall be securely fastened to the supporting structure or wall using not less than four 6.4 mm (1/4 inch) bolts. The use of sheet metal screws will not be allowed.

3.11 GROUNDING

Grounding shall be in conformance with NFPA 70, the contract drawings, and the following. Grounding conductors shall be soft-drawn, stranded copper. Ground rods shall be driven into the earth so that after the installation is complete, the top of the ground rod will be approximately 300 mm below finished grade, except in handholes.

3.11.1 Ground Rods

The resistance to ground shall be measured using the fall-of-potential method described in IEEE Std 81. The maximum resistance of a driven ground rod shall not exceed 25 ohms under normally dry conditions. Whenever the required ground resistance is not met, additional electrodes shall be provided interconnected with grounding conductors, to achieve the specified ground resistance. The additional electrodes shall be up to three, 3 m long rods spaced a minimum of 3 m apart. In high ground resistance, UL listed chemically charged ground rods may be used. If the resultant resistance

exceeds 25 ohms measured not less than 48 hours after rainfall, the Contracting Officer shall be notified immediately. Connections below grade shall be fusion welded. Connections above grade shall be fusion welded or shall use UL 467 approved connectors.

3.11.2 Items to be Grounded

Ground conductors, metallic conduits, junction boxes, and noncurrent-carrying metallic parts of equipment shall be grounded. Connections above grade shall be made with solderless connectors, and those below grade shall be made by a fusion-welding process.

3.11.3 Lighting Pole

One ground rod shall be provided at each pole. Bases of metal or concrete lighting poles shall be connected to ground rods by means of No. 8 AWG bare copper wire. Lighting fixture brackets on wood and concrete poles shall be grounded to a No. 6 AWG bare copper grounding conductor connected to the ground rod.

3.11.4 Handhole

In each handhole, at a convenient point close to the wall, a ground rod shall be driven into the earth before the floor is poured, and approximately 100 mm of the ground rod shall extend above the floor after pouring. When precast concrete units are used, the top of the ground rod may be below the floor, and a No. 1/0 AWG copper ground conductor shall be brought inside through a watertight sleeve in the wall. Connection to ground rods shall be by means of bolted-clamp terminals or by an approved fusion-welding process. Ground wires shall be neatly and firmly attached to handhole walls, and the amount of exposed bare wire shall be held to a minimum.

3.11.5 Metal Cable Boxes

Metal cable boxes for direct-burial cable shall be connected to adjacent ground rods by wires with current-carrying capacities of at least 20 percent of the spliced phase conductors, but not less than No. 6 AWG.

3.12 TESTS

3.12.1 Operating Test

After the installation is completed and at such time as the Contracting Officer may direct, the Contractor shall conduct an operating test for approval. The equipment shall be demonstrated to operate in accordance with the requirements specified. The test shall be performed in the presence of the Contracting Officer. The Contractor shall furnish instruments and personnel required for the test, and the Government will furnish the necessary electric power.

3.12.2 Ground Resistance Measurements

The resistance to ground shall be measured by the fall-of-potential method described in IEEE Std 81.

END OF SECTION

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SECTION 16710

PREMISES DISTRIBUTION SYSTEM

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

ELECTRONIC INDUSTRIES ALLIANCE (EIA)

ANSI/TIA/EIA-568-A	(1995) Commercial Building Telecommunications Cabling Standard
ANSI/TIA/EIA-568-A-5	(2000) Transmission Performance Specifications for 4-pair 100 ohm Category 5E Cabling
ANSI/TIA/EIA-569-A	(1998) Commercial Building Standard for Telecommunications Pathways and Spaces
ANSI/TIA/EIA-607	(1994) Commercial Building Grounding and Bonding Requirements for Telecommunications
TIA/EIA TSB 67	(1995) Transmission Performance Specifications for Field Testing of Unshielded Twisted-Pair Cabling Systems

IBM CORPORATION (IBM)

IBM GA27-3361-07	(1987) LAN Cabling System - Planning and Installation
IBM GA27-3773-0	(1987) Cabling System Technical Interface Specifications

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-80-576	(1994) Communications Wire and Cable for Wiring of Premises
ICEA S-83-596	(1994) Fiber Optic Premises Distribution Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70	(2002) National Electrical Code
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UNDERWRITERS LABORATORY (UL)

UL 50	(1995; Rev through Nov 1999) Enclosures for Electrical Equipment
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1.2 SYSTEM DESCRIPTION

The premises distribution system shall consist of inside-plant horizontal, riser, and backbone cables and connecting hardware to transport telephone and data (including LAN) signals between equipment items in a building. The Contractor shall coordinate all work with the 1115th Signal Command, also

referred to as the Directorate of Information Management(DOIM); point of contact is Cliff Hawkeswood, telephone 253-967-6789. There is no charge by the DOIM for this work.

1.3 ENVIRONMENTAL REQUIREMENTS

Connecting hardware shall be rated for operation under ambient conditions of 0 to 60 degrees C (32 to 140 degrees F) and in the range of 0 to 95 percent relative humidity, noncondensing.

1.4 QUALIFICATIONS

1.4.1 Contractor Qualifications

All telecommunications work shall be performed by certified telecommunications contractors and installers. Telecommunications apprentices, if used, shall be closely supervised. No more than 2 apprentices per journeyman installer shall be permitted in performing the work. All telecommunications equipment shall be furnished and installed by a Washington State Department of Labor and Industries certified, licensed electrical telecommunications (Electrical Contractor TELECOM Contractor). The contractor shall have the following qualifications:

a. Minimum Contractor Experience

The contractor shall have a minimum of 4 years experience in the application, installation, and testing of specified systems and equipment. Specific knowledge of the Army I3A telecommunications guide, EIA/TIA standards, and Fort Lewis telecommunications system is preferable. The contractor shall be a certified installer on telecommunications infrastructure components and show proof thereof. The contractor shall submit a 1-3 page narrative description of the proposed telecommunications contractor describing the firm's recent experience and qualifications, contractors telecom license, together with an organization chart showing the specific administrators, installers, and other telecommunications workers proposed for the project.

b. Minimum Qualifications of Key Positions

Contractors shall identify telecommunications installers and administrators by name. Contractors shall provide the proposed staff qualifications as stated below for personnel positions to perform work for this contract (i.e., qualifications a person must possess to fill each position). The Contractor personnel must meet the minimum staff qualifications shown below. The Government will provide more credit to firms proposing better experience.

- (1) Certified telecommunications administrators and installers assigned to the installation of this system or any of its components shall have appropriate training and State Department of Labor and Industries certification that they are qualified to install and test the provided products. Administrators shall have a minimum of 4 years recent, relevant experience supervising the installation of telecommunications systems.
- (2) Installers assigned to the installation of this system or any of its components shall have a minimum of 3 years recent work experience in the installation of EIA/TIA specified copper and fiber optic cable and components.
- (3) Work shall be supervised by a certified telecom administrator. The administrator shall be available to installers any time work is being performed and will review and approve all aspects of the work.

c. Qualifications of Proposed Key Personnel

Provide resumes for your telecommunications telecom administrator (s) and installers who will perform work under the contracts resulting from this solicitation. As a minimum, provide resumes for the disciplines identified above and any additional positions that are identified by your firm. Resumes should be no more than one (1) page per individual and shall, as a minimum, contain the following information:

- ?? Name of individual
- ?? Relevant education and training
- ?? Registration, telecom certification, and/or professional licenses (where when received and if it is current), if applicable,
- ?? Specific qualifications/experience for performing the proposed work,
- ?? Years with the firm,
- ?? Relevant projects to include project name, location, dollar value, year worked on the project, and duties/functions on the project.
- ?? References for recently completed work.

d. Staff Substitutions

No substitutions of telecommunication contractor staff will be allowed following contract award without the express written approval of the Government. Contractor requests for telecommunications subcontractor personnel substitutions shall be made in writing at least four weeks prior to scheduled telecommunications work. Substitutions will generally be discouraged.

e. Evaluation and Rating of Qualifications

Consideration will be given to the *relevance*, quality and depth of experience and *qualifications* required by the contractor for each key position and each key personnel. The greater *relevance*, quality, depth of experience and the qualifications required by the contractor for the key positions and proposed personnel, the higher the rating assigned. Failure to meet the minimum requirements may result in a disqualification of the bid as non-responsive.

1.4.2 Minimum Manufacturer Qualifications

The equipment and hardware provided under this contract will be from manufacturers that have a minimum of 3 years experience in producing the types of systems and equipment specified.

1.5 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals without a designation are for information only. The following shall be submitted in accordance with Section 01330
SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Premises Distribution System; G

Detail drawings including a complete list of equipment and material. Detail drawings shall contain complete wiring and schematic diagrams and other details required to demonstrate that the system has been coordinated and will function properly as a system. Drawings shall include vertical riser diagrams, equipment rack details, elevation drawings of telecommunications closet walls, outlet face plate details for all outlet configurations, sizes and types of all cables, conduits, and cable trays. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operation.

Record Drawings; G.

Record drawings for the installed wiring system infrastructure per ANSI/TIA/EIA-606. The drawings shall show the location of all cable terminations and location and routing of all backbone and horizontal cables. The identifier for each termination and cable shall appear on the drawings.

SD-03 Product Data

Record Keeping and Documentation; G.

Documentation on cables and termination hardware in accordance with ANSI/TIA/EIA-606.

Spare Parts;

Lists of spare parts, tools, and test equipment for each different item of material and equipment specified, after approval of detail drawings, not later than 2 months prior to the date of beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply, and a list of spare parts recommended for stocking.

Manufacturer's Recommendations; G

Where installation procedures, or any part thereof, are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations, prior to installation shall be provided. Installation of the item will not be allowed to proceed until the recommendations are received and approved.

Test Plan; G.

Test plan defining the tests required to ensure that the system meets technical, operational and performance specifications, 60 days prior to the proposed test date. The test plan must be approved before the start of any testing. The test plan shall identify the capabilities and functions to be tested, and include detailed instructions for the setup and execution of each test and procedures for evaluation and documentation of the results.

Qualifications; G

The qualifications of the Manufacturer, Contractor, and the Installer to perform the work specified herein. This shall include proof of the minimum qualifications specified herein.

SD-06 Test Reports

Test Reports;

Test reports in booklet form with witness signatures verifying execution of tests. Test results will also be provided on compact discs in ASCII format. Reports shall show the field tests performed to verify compliance with the specified performance criteria. Test reports shall include record of the physical parameters verified during testing. Test reports shall be submitted within 14 days after completion of testing.

SD-07 Certificates

Materials and Equipment;.

Where materials or equipment are specified to conform, be constructed or tested to meet specific requirements, certification that the items provided conform to such requirements. Certification by a nationally recognized testing laboratory that a representative sample has been tested to meet the requirements, or a published catalog specification statement to the effect that the item meets the referenced standard, will be acceptable as evidence that the item conforms. Compliance with these requirements does not relieve the Contractor from compliance with other requirements of the specifications.

Installers; G

The Contractor shall submit certification that all the installers are factory certified to install and test the provided products and shall provide proof that the minimum qualifications specified are met.

1.6 DELIVERY AND STORAGE

Equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust or other contaminants.

1.7 OPERATION AND MAINTENANCE MANUALS

Commercial off the shelf manuals shall be furnished for operation, installation, configuration, and maintenance for all products provided as a part of the premises distribution system. Specification sheets for all cable, connectors, and other equipment shall be provided.

1.8.2 Termination Hardware

A record of all installed patch panels and outlets shall be provided in hard copy format on electronic media using Windows based computer cable management software.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of the products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 1 year prior to installation. Materials and equipment shall conform to the respective publications and other requirements specified below and to the applicable requirements of NFPA 70.

2.2 UNSHIELDED TWISTED PAIR CABLE SYSTEM

2.2.1 Backbone Cable

Backbone cable shall meet the requirements of ICEA S-80-576 and ANSI/TIA/EIA-568-A for Category 5e 100-ohm unshielded twisted pair cable. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Conductors shall be solid untinned copper 24 AWG. Cable shall be rated CMR for non-plenum use or CMP for use in plenums per NFPA 70. All cables shall be labeled at both ends.

2.2.2 Horizontal Cable

Horizontal cable shall meet the requirements of ANSI/TIA/EIA-568-A-5 for Category 5e. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Cable shall be rated CMG for non-plenum use or CMP for use in plenums per NFPA 70. All cables shall be labeled at both ends.

2.2.3 Connecting Hardware

Connecting and cross-connecting hardware shall be the same category as the cable it serves. Hardware shall be in accordance with ANSI/TIA/EIA-568-A.

2.2.3.1 Telecommunications Outlets

Desk outlet plates in Administrative and Office areas shall come equipped with four modular jacks. Wall outlets and outlets in non-administrative areas shall come equipped with a single modular jack. Faceplates shall be provided and shall be ivory in color, impact resistant plastic. Voice jacks shall match the faceplate color and shall be the 6-pin type. Data jacks shall be blue in color and shall be the 8-pin type. Outlet assemblies used in the premises distribution system shall consist of individual modular jacks in single gang covers and shall be wired as indicated on the drawings. The modular jacks shall conform to the requirements of ANSI/TIA/EIA-568-A, and shall be rated for use with Category 5e cable in accordance with ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in TIA/EIA TSB 67 and supplemented by ANSI/TIA/EIA-568-A-5. Modular jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-A. Modular jacks shall be unkeyed .

2.2.3.2 Patch Panels

Patch panels shall consist of eight-position modular jacks, with rear mounted type 110 insulation displacement connectors, arranged in rows or columns on 480mm (19 inches) rack mounted panels. Jack pin/pair configuration shall be T568A per ANSI/TIA/EIA-568-A. Jacks shall be unkeyed. Jacks shall be labeled in numerical sequence. The modular jacks shall conform to the requirements of ANSI/TIA/EIA-568-A, and shall be rated for use with Category 5e cable in accordance with ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in TIA/EIA TSB 67 and supplemented by ANSI/TIA/EIA-568-A-5.

2.2.3.3 Patch Cords

Patch cords shall be cable assemblies consisting of flexible, twisted pair stranded wire with eight-position plugs at each end. Cable shall be label-verified. Cable jacket shall be factory marked at regular intervals indicating verifying organization and performance level. Patch cords shall be wired straight through; pin numbers shall be identical at each end and shall be paired to match T568A patch panel jack wiring per ANSI/TIA/EIA-568-A. Patch cords shall be unkeyed. Patch cords shall be factory assembled. Patch cords shall conform to the requirements of ANSI/TIA/EIA-568-A-5 for Category 5e. Three hundred 3m (10 foot) cords shall be provided.

2.2.3.4 Terminal Blocks

Terminal blocks shall be wall mounted wire termination units consisting of insulation displacement connectors mounted in plastic blocks, frames or housings. Blocks shall be type 66 which meet the requirements of ANSI/TIA/EIA-568-A, and shall be rated for use with Category 5e cable in accordance with ANSI/TIA/EIA-568-A-5 and shall meet the Link Test parameters as listed in TIA/EIA TSB 67 and supplemented by ANSI/TIA/EIA-568-A-5. Blocks shall be mounted on standoffs and shall include cable management hardware. Insulation displacement connectors shall terminate 22 or 24 gauge solid copper wire as a minimum, and shall be connected in pairs so that horizontal cable and connected jumper wires are on separate connected terminals.

2.5 FIBER OPTIC CABLE SYSTEM

2.5.3 Connecting Hardware

2.5.3.1 Connectors

Connectors shall be ST type with ceramic ferrule material with a maximum insertion loss of 0.5 dB. Connectors shall meet performance requirements of ANSI/TIA/EIA-568-A. Connectors shall be field installable. Connectors shall utilize adhesive for fiber attachment to ferrule. Connectors shall terminate fiber sizes as required for the service.

2.5.3.2 Patch Panels

Patch panels shall be a complete system of components by a single manufacturer, and shall provide termination, splice storage, routing, radius limiting, cable fastening, storage, and cross-connection. Patch panels shall be 480 mm (19 inch) rack mounted panels. Patch panels shall provide strain relief for cables. Panels shall be labeled with alphanumeric x-y coordinates. Patch panel connectors and couplers shall be the same type and configuration as used elsewhere in the system.

2.6 EQUIPMENT RACKS

2.6.1 Floor Mounted Open Frame

Floor mounted equipment racks shall be welded steel or aluminum relay racks with uprights to mount equipment 480mm (19 inches) wide. Uprights shall be 75mm (3 inch) deep channel, 32mm (1-1/4 inches) wide, drilled and tapped 12-24 in a 13mm (1/2 inch) pattern. Racks shall be provided with a standard top crossmember, and predrilled base plate to allow floor fastening. Open frame equipment racks shall be 2.1m (7 feet) in height and painted AC outlets shall be provided as shown.

2.6.2 Wall Mounted Open Frame

Wall mounted open frame equipment racks shall be steel or aluminum relay racks to mount equipment 480mm (19 inches) wide with standoff brackets for wall mounting. Uprights shall be drilled and tapped 12-24 in a 13mm (1/2 inch) pattern. Standoff brackets shall be of sufficient length for a 150mm (6 inch) clearance between rack and wall. Wall mounted open frame racks shall be hinged. AC outlets shall be provided as shown.

2.6.3 Cable Guides

Cable guides shall be specifically manufactured for the purpose of routing cables, wires and patch cords horizontally and vertically on 480mm (19 inch) equipment racks. Cable guides shall consist of ring or bracket-like devices mounted on rack panels for horizontal use or individually mounted for vertical use. Cable guides shall mount to racks by screws and/or nuts and lockwashers.

2.7 EQUIPMENT MOUNTING BACKBOARD

Plywood backboards shall be provided, sized as shown, painted with white or light colored paint.

2.8 TELECOMMUNICATIONS OUTLET BOXES

Electrical boxes for telecommunication outlets shall be 117mm (4-11/16 inch) square by 53mm (2-1/8 inches) deep with minimum 9mm (3/8 inch) deep single or two gang plaster ring as shown. Provide a minimum 25mm (1 inch) conduit.

PART 3 EXECUTION

3.1 INSTALLATION

System components and appurtenances shall be installed in accordance with NFPA 70, manufacturer's instructions and as shown. Necessary interconnections, services, and adjustments required for a complete and operable signal distribution system shall be provided. Components shall be labeled as indicated. Penetrations in fire-rated construction shall be firestopped in accordance with Section 07840 FIRESTOPPING. Conduits, outlets and raceways shall be installed in accordance with Section 16415 ELECTRICAL WORK, INTERIOR. Wiring shall be installed in accordance with ANSI/TIA/EIA-568-A and as specified in Section 16415 ELECTRICAL WORK, INTERIOR. Wiring, and terminal blocks and outlets shall be marked as indicated. Cables shall not be installed in the same cable tray, utility pole compartment, or floor trench compartment with ac power cables. Cables not installed in conduit or

wireways shall be properly secured and neat in appearance and, if installed in plenums or other spaces used for environmental air, shall comply with NFPA 70 requirements for this type of installation.

3.1.1 Horizontal Distribution Cable

The rated cable pulling tension shall not be exceeded. Cable shall not be stressed such that twisting, stretching or kinking occurs. Cable shall not be spliced. Fiber optic cables shall be installed either in conduit or through type cable trays to prevent microbending losses. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items. Placement of cable parallel to power conductors shall be avoided, if possible; a minimum separation of 300mm (12 inches) shall be maintained when such placement cannot be avoided. Cables shall be terminated; no cable shall contain unterminated elements. Minimum bending radius shall not be exceeded during installation or once installed. Cable ties shall not be excessively tightened such that the transmission characteristics of the cable are altered. Pull wires shall be provided where indicated. The pull wire shall be of No. 14 AWG zinc-coated steel, or of plastic having not less than 1.4 MPa (200 psi) tensile strength. Not less than 254mm (10 inches) of slack shall be left at each end of the pull wire.

3.1.2 Riser and Backbone Cable

Vertical cable support intervals shall be in accordance with manufacturer's recommendations. Cable bend radius shall not be less than ten times the outside diameter of the cable during installation and once installed. Maximum tensile strength rating of the cable shall not be exceeded. Cable shall not be spliced.

3.1.3 Telecommunications Outlets

3.1.3.1 Faceplates

As a minimum each jack shall be labeled as to its function and a unique number to identify cable link. Labels designations shall be as shown on the drawings.

3.1.3.2 Cables

Unshielded twisted pair and fiber optic cables shall have a minimum of 150 mm (6 inches) of slack cable loosely coiled into the telecommunications outlet boxes. Minimum manufacturers bend radius for each type of cable shall not be exceeded.

3.1.3.3 Pull Cords

Pull cords shall be installed in all conduit serving telecommunications outlets which do not initially have fiber optic cable installed.

3.1.4 Terminal Blocks

Terminal blocks shall be mounted in orderly rows and columns as indicated. Adequate vertical and horizontal wire routing areas shall be provided between groups of blocks. Industry standard wire routing guides shall be utilized. Prior to cable termination, Contractor shall verify block layout with the DOIM.

3.1.5 Unshielded Twisted Pair Patch Panels

Patch panels shall be mounted in equipment racks with sufficient modular jacks to accommodate the installed cable plant plus 10 percent spares. Cable guides shall be provided above, below and between each panel.

3.1.6 Fiber Optic Patch Panels

Patch panels shall be mounted in equipment racks with sufficient ports to accommodate the installed cable plant plus 10 percent spares. A slack loop of fiber shall be provided within each panel. Loop shall be 900mm (3 feet) in length. The outer jacket of each cable entering a patch panel shall be secured to the panel to prevent movement of the fibers within the panel, using clamps or brackets specifically manufactured for that purpose.

3.1.7 Equipment Racks

Open frame equipment racks shall be bolted to the floor. Cable guides shall be bolted or screwed to racks. Racks shall be installed level. Ganged racks shall be bolted together. Ganged racks shall have adjacent side panels removed. Each rack shall be braced with local seismic level bracing in accordance with Section 13080 .

3.1.8 Rack Mounted Equipment

Equipment to be rack mounted shall be securely fastened to racks by means of the manufacturer's recommended fasteners.

3.2 TERMINATION

Cables and conductors shall sweep into termination areas; cables and conductors shall not bend at right angles. Manufacturer's minimum bending radius shall not be exceeded. When there are multiple system type drops to individual workstations, relative position for each system shall be maintained on each system termination block or patch panel.

3.2.1 Unshielded Twisted Pair Cable

Each pair shall be terminated on appropriate outlets, terminal blocks or patch panels. No cable shall be unterminated or contain unterminated elements. Pairs shall remain twisted together to within the proper distance from the termination as specified in ANSI/TIA/EIA-568-A. Conductors shall not be damaged when removing insulation. Wire insulation shall not be damaged when removing outer jacket.

3.2.4 Fiber Optic Cable

Each incoming single mode fiber shall have connectors installed. The pull strength between the connector and the attached fiber shall be not less than 11.3 kg (25 pounds). The mated pair loss, without rotational optimization, shall not exceed 1.0 dB. Fiber optic connectors shall be installed per ANSI/TIA/EIA-568-A.

3.3 GROUNDING

Signal distribution system ground shall be installed in the telecommunications entrance facility and in each telecommunications closet in accordance with ANSI/TIA/EIA-607 and Section 16415 ELECTRICAL WORK, INTERIOR. Equipment racks shall be connected to the electrical safety ground.

3.4 ADDITIONAL MATERIALS

The Contractor shall provide the following additional materials required for facility startup.

- a. 10 of each type outlet.
- b. 10 of each type cover plate.

- c. 1 of each type terminal block for each telecommunications closet.
- d. 300 Patch cords of 3 m (10 feet).
- e. 1 Set of any and all special tools required to establish a cross connect and to change and/or maintain a terminal block, including Harris lineman's speakerphone test set and punch tool, Progressive tone and probe set, and 2 LanCat system 6 or newer Cat 5e data test sets.

3.5 TESTING

Materials and documentation to be furnished under this specification are subject to inspections and tests. All components shall be terminated prior to testing. Equipment and systems will not be accepted until the required inspections and tests have been made, demonstrating that the signal distribution system conforms to the specified requirements, and that the required equipment, systems, and documentation have been provided.

3.5.1 Unshielded Twisted Pair Tests

All metallic cable pairs shall be tested for proper identification and continuity. All opens, shorts, crosses, grounds, and reversals shall be corrected. Correct color coding and termination of each pair shall be verified in the communications closet and at the outlet. Horizontal wiring shall be tested from and including the termination device in the communications closet to and including the modular jack in each room. Backbone wiring shall be tested end-to-end, including termination devices, from terminal block to terminal block, in the respective communications closets. These tests shall be completed and all errors corrected before any other tests are started.

3.5.2 Category 5e Circuits

All category 5e data circuits shall be tested using a test set that meets the Class II accuracy requirements of TIA/EIA TSB 67 standard, including the additional tests and test set accuracy requirements of ANSI/TIA/EIA-568-A-5. Testing shall use the Basic Link Test procedure of TIA/EIA TSB 67, as supplemented by ANSI/TIA/EIA-568-A-5. Cables and connecting hardware which contain failed circuits shall be replaced and retested to verify the standard is met.

END OF SECTION

SECTION 16711

TELEPHONE SYSTEM, OUTSIDE PLANT

PART 1 GENERAL

1.1 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI C62.61 (1993) Gas Tube Surge Arrestors on Wire Line Telephone Circuits

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 2239 (1996a) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

ELECTRONIC INDUSTRIES ASSOCIATION (EIA)

EIA ANSI/EIA 455-81A-91 (1992) FOTP-81 Compound Flow (Drip) Test for Filled Fiber Optic Cable

EIA ANSI/EIA/TIA-455-30B (1991) FOTP-30 Frequency Domain Measurement of Multimode Optical Fiber Information Transmission Capacity

EIA ANSI/EIA/TIA-455-53A (1990) FOTP-53 Attenuation by Substitution Measurement for Multimode Graded-Index Optical Fibers or Fiber Assemblies Used in Long Length Communications Systems

EIA ANSI/EIA/TIA-455-78A-98 (1990; R 1998) FOTP-78 Spectral Attenuation Cutback Measurement for Single Mode Optical Fibers

EIA ANSI/TIA/EIA-568-A (1995) Commercial Building Telecommunications Cabling Standard

EIA ANSI/TIA/EIA-607 (1994) Commercial Building Grounding and Bonding Requirements for Telecommunications

INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS (IEEE)

IEEE C2 (2002) National Electrical Safety Code

INSULATED CABLE ENGINEERS ASSOCIATION (ICEA)

ICEA S-85-625 (1996) Airecore, Polyolefin Insulated, Copper Conductor Telecommunications Cable

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 (2002) National Electrical Code

RURAL UTILITIES SERVICE (RUS)

REA Bulletin 345-39	(1985) Telephone Station Protectors
REA Bulletin 345-50	(1979) Trunk Carrier Systems (PE-60)
REA Bulletin 345-65	(1985) Shield Bonding Connectors (PE-33)
REA Bulletin 345-72	(1985) Filled Splice Closures (PE-74)
REA Bulletin 345-151	(1989) Conduit and Manhole Construction, REA Form 515c
REA Bulletin 1753F-205 (PE-39)	(1993) Filled Telephone Cables
REA Bulletin 1753F-207 (PE-87)	(1994) Terminating Cables
REA Bulletin 1753F-208	(1993) Filled Telephone Cables with Expanded Insulation (PE-89)
RUS Bulletin 1751F-635	(1996) Aerial Plant Construction
RUS Bulletin 1751F-643	(1998) Underground Plant Design
RUS Bulletin 1753F-302 (PE-91)	(1994) Outside Plant Housings and Serving Area Interface Systems
RUS Bulletin 1753F-401(PC-2)	(1995) Splicing Copper and Fiber Optic Cables
RUS REA Bulletin 1751F-641	(1995) Construction of Buried Plant
RUS REA Bull 1753F-201 (PC-4)	(1997) Acceptance Tests and Measurements of Outside Plant
RUS REA Bull 1753F-601 (PE-90)	(1994) Filled Fiber Optic Cables
RUS REA Bulletin 1755I-100	(1999) List of Materials Acceptable for Use on Telecommunications Systems of RUS Borrowers

UNDERWRITERS LABORATORIES (UL)

UL 50	(1995; Rev through Oct 1997) Enclosures for Electrical Equipment
UL 497	(1995; Rev Mar 1996) Protectors for Paired Conductor Communication Circuits

1.2 SYSTEM DESCRIPTION

The outside plant system shall consist of all cable, conduit, manholes, poles, etc. required to provide signal paths from the closest point of presence to the new facility, including free standing frames or backboards, terminating cables, lightning and surge protection modules at the entry facility. The work consists of furnishing, installing, testing and making operational a complete outside plant system for continuous use. The Contractor shall coordinate all work with the 1115th Signal Command, also referred to as Directorate of Information Management (DOIM); Point of Contact is Cliff Hawkeswood, telephone 253-967-6789. There is no charge by the DOIM for this work.

- a. The Contractor shall coordinate with the DOIM all the work required in the RSU to provide and install all new main distribution frame extensions, termination equipment, and cables for a complete outside plant system. Confirmation and identification of existing cables to be spliced and for splice pairs assignments shall be provided by the DOIM. Contractor shall provide 7 days notification before performing any splice to an existing cable.
- b. The Contractor shall coordinate with the DOIM for termination locations on the new main distribution frame of RSU building for outside plant cable.
- c. The Contractor shall coordinate with the DOIM for final cable names.
- d. The Contractor shall coordinate with the DOIM for Government furnished, Government installed instruments. Contractor shall provide supporting structures, wiring, and other equipment as indicated; and test before hand.

1.3 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. The following shall be submitted in accordance with Section 01330 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Telephone System; G
Installation; G

Detail drawings, consisting of a complete list of equipment and material, including manufacturer's descriptive and technical literature, performance charts and curves, and catalog cuts. Detail drawings shall also contain complete configuration information, wiring diagrams and any other details required to demonstrate that the cable system has been coordinated to support the transmission systems identified in the specifications and drawings. Drawings shall show proposed layout and anchorage of equipment and appurtenances, and equipment relationship to other parts of the work including clearance for maintenance and operations.

Record Drawings; G

Record drawings for the installed wiring system showing the actual location of all cable terminations, splices, routing, and size and type of all cables. The identifier for each termination and cable shall appear on the drawings. The drawings shall include gauge and pair or fiber count for each cable, duct and innerduct arrangement, or conductor assignment of outside plant, and protector and connector block layout at the termination points after installation.

SD-03 Product Data

Spare Parts
Equipment

A data list of recommended spare parts, tools, and test equipment for each different item of material and equipment specified prior to beneficial occupancy. The data shall include a complete list of parts and supplies, with current unit prices and source of supply.

Installation; G

Printed copies of the manufacturer's recommendations for the material being installed, prior to installation. Installation of the item will not be allowed to proceed where installation procedures, or any part thereof, are required to be in accordance with those recommendations until the recommendations are received and approved.

Acceptance Tests; G

Test plans defining all tests required to ensure that the system meets specified requirements. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

Cutover and Records; G

The cutover plan shall provide procedures and schedules for relocation of facility station numbers without interrupting service to any active location.

SD-06 Test Reports

Acceptance Tests

Test reports in booklet form showing all field tests performed, upon completion and testing of the installed system. Measurements shall be tabulated on a pair by pair or strand by strand basis.

SD-07 Certificates

Telephone System; G

Proof that the items furnished under this section conform to the specified requirements in FCC, ICEA, REA, RUS, ANSI, ASTM, NFPA, EIA, or UL, where materials and equipment are so specified.

Qualifications; G

The qualifications of the manufacturer, splicer, installer, and installation supervisor as specified.

1.4 QUALIFICATIONS

1.4.1 Cable Installers

Installation shall be under the direct supervision of an individual with a minimum of 3 years experience in the installation of the specified copper and fiber optic cable and components.

1.4.2 Cable Splicing and Termination

All cable splicers shall have training in the proper techniques and have a minimum of 3 years experience in splicing and terminating the specified cables. Modular splices shall be performed by factory certified personnel or under direct supervision of factory trained personnel for products used.

1.4.3 Manufacturers

The cable, equipment, and hardware provided shall be from manufacturers that have a minimum of 3 years experience in producing the types of cable, equipment, and hardware specified.

1.5 DELIVERY AND STORAGE

1.5.1 Cable Requirements

All cable shall be shipped on reels. The diameter of the drum shall be large enough to prevent damage to the cable during reeling and unreeling. The reels shall be constructed to prevent damage during shipment and handling. The outer end of the cable shall be securely fastened to the reel head to prevent the cable from becoming loose in transit. The inner end of the cable shall project into a slot in the side of the reel, or into a housing on the inner slot of the drum, with sufficient length to make it available for testing. The inner end shall be fastened to prevent the cable from becoming loose during installation. End seals shall be applied to each of the cables to prevent moisture from entering the cable. The reels with cable shall be suitable for outside storage conditions when the temperature ranges from minus 40 to plus 65 degrees C (minus 40 to plus 148 degrees F) with relative humidity from 0 to 100 percent.

1.5.2 Equipment

All equipment shall be stored with protection from the weather, humidity and temperature variations, dirt and dust, or other contaminants, in accordance with the manufacturer's requirements.

PART 2 PRODUCTS

2.1 STANDARD PRODUCTS

Materials and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture of such products and shall be the manufacturer's latest standard design that has been in satisfactory use for at least 2 years prior to bid opening. Each major component of equipment shall have the manufacturer's name and type identified on the equipment. All products supplied shall be specifically designed and manufactured for use with outside plant communications systems. All items of the same class of equipment shall be the products of a single manufacturer.

2.2 CABLE

2.2.1 Copper Conductor Cable

Copper conductor cable shall conform to the following:

2.2.1.1 Underground

Cable shall be manufactured per REA Bulletin 1753F-205 (PE-39) or REA Bulletin 1753F-208. A 0.2 mm (8 mil) coated aluminum or 0.12 mm (5 mil) copper metallic shield shall be provided.

2.2.1.2 Screened

Screened cable shall comply with REA Bulletin 1753F-205 (PE-39) or REA Bulletin 1753F-208.

2.2.2 Fiber Optic Cable

Fiber optic cable shall be specifically designed for outside use with tight or loose buffer construction. The tight buffer optical fiber cable shall consist of a central glass optical fiber surrounded by a soft intermediate buffer to allow for thermal expansions and proper fitting of the secondary buffer. The

loose buffer optical fiber cable shall have the glass optical fiber within a filled loose tube. All fiber optic cables used shall conform to the requirements of RUS REA Bull 1753F-601 (PE-90) including any special requirements made necessary by a specialized design.

2.2.2.1 Cable Cores

A central, nonmetallic core member shall be included to serve as a cable core foundation to reduce strain on the fibers, but not to serve as a pulling strength member.

2.2.2.2 Optical Fiber

Optical Fiber Cables shall have 24 fibers. Multiple cables shall be provided as required for installation without splices. Optical fibers shall be single mode.

2.2.2.3 Performance Requirements

The fiber optic cable shall comply with the specified mechanical performance requirements while used in buried and underground duct applications where the temperature varies from minus 20 to plus 60 degrees C. (minus 5 to plus 140 degrees F.) Optical performance degradation shall be less than 5 percent of the optical performance requirements in the temperature range of minus 20 to plus 60 degrees C. (minus 5 to plus 140 degrees F.) The fiber optic cable shall not be damaged in storage where the temperature may vary from minus 40 to plus 65 degrees C. (minus 40 to plus 148 degrees F.)

2.3 CLOSURES

2.3.1 Copper Conductor Closures

2.3.1.1 Underground Closure

Underground closures shall conform to REA Bulletin 345-72. The closure shall be of thermoplastic, thermoset, or stainless steel material and be suitable for use in a vault or manhole. No encapsulating compounds may be used. Splice cases shall form an airtight seal without the use of encapsulating compounds. All splice cases shall be "Flash Tested" after installation.

2.3.2 Fiber Optic Closures

2.3.2.1 Fiber Optic Underground

No underground splices shall be allowed. Contractor shall provide the specified fiber optic cable from the nearest existing ADN (installed in previous project) to the building's communication room in one continuous unspliced length.

2.4 CABLE SPLICES AND ORGANIZERS

2.4.1 Copper Cable Splices

All cables greater than 25 pairs shall be spliced using modular splicing connectors, which accommodate 25 pairs of conductors at a time. The correct connector size shall be used to accommodate the wire gauge of the cable to be spliced. The connectors used shall be listed in RUS REA Bulletin 1755I-100.

2.5 CABLE TERMINALS

2.5.1 Pedestal-Type Cable Terminals

Pedestal-type cable terminals shall conform to RUS Bulletin 1753F-302 (PE-91).

2.5.2 Cross-connect Cable Terminals

Cross-connect cable terminals shall be weatherproofed for outdoor use and suitable for pole, pad, or stake mounting. The terminal shall be equipped with mounting columns and distribution rings for jumper-wire routing. The terminal shall be of aluminum or steel construction and ribbed for strength.

2.6 MANHOLE AND DUCT

All manhole and duct products shall conform to RUS Bulletin 1751F-643.

2.6.1 New Manholes

New manholes shall be equipped with pulling-in irons, cable racks, ladder and ground rod, and shall conform to the requirements of REA Bulletin 345-151. Manholes shall be Utility Vault 38Y 612 TCA communications manhole or approved equal.

2.6.2 Duct/Conduit

Conduit shall be furnished as specified in Sections 16415 ELECTRICAL WORK, INTERIOR and 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND and as shown on project drawings.

2.6.3 Innerduct

Innerduct shall be SDR 11.5 polyethylene plastic pipe conforming to ASTM D 2239.

2.7 EQUIPMENT RACKS

Racks shall be as specified in Section 16710 PREMESIS DISTRIBUTION SYSTEM and as shown.

2.8 MISCELLANEOUS ITEMS

2.8.1 Shield Connectors

Shield connectors shall make a stable, low-impedance electrical connection between the shield of the communications cable and a conductor such as a strap, bar, or wire. The connector shall be made of tin-plated tempered brass. Shield bond connectors shall comply with REA Bulletin 345-65.

2.8.2 Grounding Braid

Grounding braid shall provide low electrical impedance connections for dependable shield bonding. The braid shall be made from flat tin-plated copper.

2.8.3 Warning Tape

Marking and locating tape shall be acid and alkali resistant polyethylene film, 150 mm (6 inches) wide with a minimum strength of 12.1 MPa (1750 psi) lengthwise and 10.3 MPa (1500 psi) crosswise. The tape shall be manufactured with integral wires, foil backing, or other means to enable detection by a metal detector when the tape is buried up to 1 m (3 feet) deep. The metallic core shall be encased in a protective jacket or provided with other means to protect it from corrosion and shall be specifically manufactured for marking and locating underground utilities. The warning tape shall be orange in color and continuously imprinted with the words "WARNING - COMMUNICATIONS CABLE BELOW" at not more than 1.2 m (48 inch) intervals.

2.8.4 Cable Warning Signs

Cable warning signs, which identify the route of buried cable, shall be stake mounted. The stake shall be driven into undisturbed soil and the sign shall be mounted to the stake in accordance with the manufacturer's instructions. Warning signs shall be placed at intervals of no more than 152.5 m (500 feet) and at each change of direction in the cable route. Warning signs shall also be placed on each side of every crossing of surface obstacles such as roads, railroads, stream crossings, or any similar crossing where excavation is likely to occur.

PART 3 EXECUTION

3.1 INSTALLATION

All system components and appurtenances shall be installed in accordance with the manufacturer's instructions and as shown. All installation work shall be done in accordance with the safety requirements set forth in the general requirements of IEEE C2 and NFPA 70.

3.1.1 Cable Inspection and Repair

All cable and wire used in the construction of the project shall be handled with care. Each reel shall be inspected for cuts, nicks or other damage. All damage shall be repaired to the satisfaction of the Contracting Officer. The reel wrap shall remain intact on the reel until the cable or wire is ready to be placed.

3.1.2 Underground Cable

Underground cable installation shall be accomplished in accordance with the requirements set forth in RUS REA Bulletin 1751F-641.

3.1.2.1 Cable Pulling

For cable installed in ducts and conduit, a cable feeder guide shall be used, between the cable reel and the face of the duct and conduit, to protect the cable and guide it into the duct and conduit as it is paid off the reel. As the cable is paid off the reel, it shall be inspected for jacket defects. Precautions shall be taken during installation to prevent the cable from being kinked or crushed. A pulling eye shall be attached to the cable and used to pull the cable through the duct and conduit system. Cable shall be hand fed and guided through each manhole. As the cable is paid off the reel into the cable feeder guide, it shall be sufficiently lubricated with a type of lubricant recommended by the cable manufacturer. Where the cable is pulled through a manhole, additional lubricant shall be applied at all intermediate manholes. Dynamometers or load-tension instruments shall be used to ensure that the pulling line tension does not exceed the installation tension value specified by the cable manufacturer. The mechanical stress placed upon a cable during installation shall not cause the cable to be twisted or stretched.

3.1.2.2 Penetrations for Cable Access

Penetrations in walls, ceilings or other parts of the building, made to provide for cable access, shall be caulked and sealed. Where conduits and ducts pass through fire walls, fire partitions, above grade floors, and fire rated chase walls, the penetration shall be sealed with fire stopping materials as specified in section 07840 FIRE STOPPING. Fire stopped penetrations shall not compromise the fire rating of the walls or floors. All underground building entries shall be through waterproof facilities.

3.1.2.3 Cable Bends

Telephone cable bends shall have a radius of not less than 10 times the cable diameter. Only large radius sweeps shall be used in conduit runs and shall not exceed a cumulative 90 degrees between manholes.

3.1.3 Manhole and Ducts

Manhole and duct systems shall be installed in accordance with Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND. Manholes shall be placed in line with the main duct. Splice cases shall be mounted in the center on the long sides. Lateral conduits shall exit the long sides near the corners. Conduits shall enter and exit the manholes in the lowest available manhole portals. Manholes shall be buried 1m (36 inches) below finished grade with riser rings and ring collars assemblies.

3.1.3.1 Innerduct Installation

Innerduct shall be pulled through existing duct-manhole system in continuous sections. Splices, joints, couplings, or connections of any type will not be allowed between manholes. Innerduct shall be plugged at both ends with polyurethane foam duct seal; this material shall also be inserted between the innerduct and the duct if cables are placed in the innerducts. Only one cable shall be installed in a given innerduct. Existing and new unoccupied innerducts shall be trimmed leaving 50 mm 2 inches exposed.

3.1.3.2 Pull Cord

Pull cords of 10 mm (3/8 inch) polypropylene shall be installed in all unused ducts and innerducts with a minimum of 610 mm (2 feet) spare cord protruding from each end.

3.1.5 Surge Protection

Except for fiber optic cable, all cables and conductors, which serve as communication lines, shall have surge protection meeting the requirements of REA Bulletin 345-50 installed at the entry facility.

3.2 SPLICING

Splicing of copper conductor cables into one continuous length is required. All pairs shall be spliced, including those indicated as dead pairs unless otherwise noted. Splicing shall be in accordance with industry standards. The completed splices shall not cause the connected cable to fail to meet the same performance and mechanical specifications of a single similar cable of the same overall length. Plastic insulated conductors shall be spliced using self-piercing electrical filled connectors, such as PICA-A-Bond conductors, or other filled connectors suitable for splicing plastic insulated cable. Connectors shall be placed using a tool specifically designed to place those connectors. Modular splicing techniques shall be utilized on all mainline splices using 3M Company, 25 pair, modular (MS2) splice connectors, type 400 DWP with sealant boxes. Other variations such as Super Mini half-tap modules shall be utilized as required. Filled connectors and sealant boxes shall be used wherever applicable. All outside cable splices shall be watertight. Cable sheaths shall be bonded together at all cable splices with bonding harness to maintain sheath continuity. Splices shall be grounded to the manhole/handhole ground system. Deviation from the cable splicing arrangements shown on the project drawings will not be allowed except as specifically approved by the Contracting Officer.

3.2.1 Closures: As needed, type to be determined by Fort Lewis (OSP) Out Side Plant, personnel.

3.2.1.1 Underground: All underground splice cases shall be Preformed splice cases or equal and shall be flash tested. Encapsulating compounds shall not be used.

3.2.2 Copper Conductor Splices

Copper conductor cable splicing shall be accomplished in accordance with RUS Bulletin 1753F-401(PC-2). Modular splicing shall be used on all cables larger than 25 pairs.

3.3 GROUNDING

Except where specifically indicated otherwise, all exposed non-current carrying metallic parts of telephone equipment, cable sheaths, cable splices, and terminals shall be grounded. Grounding shall be in accordance with requirements of NFPA 70, Articles 800-33 and 800-40.

3.3.1 Ground Bars

3.3.1.1 Telecommunications Master Ground Bar (TMGB)

A copper TMGB shall be provided, in accordance with EIA ANSI/TIA/EIA-607, to be the hub of the basic grounding system by providing a common point of connection for ground from outside cable, MDF, and equipment. The TMGB shall have a ground resistance, including ground, of 10 ohms or less.

3.3.1.2 Telecommunications Ground Bar (TGB)

Copper TGB shall be provided in accordance with EIA ANSI/TIA/EIA-607 in each communications closet and room and each frame. The TGB shall be connected to the TMGB in accordance with EIA ANSI/TIA/EIA-607. Each TGB shall be connected to the TMGB by the most direct route utilizing a copper wire conductor with a total resistance of less than 0.01 ohms.

3.3.2 Incoming Outside Plant Cables

All incoming outside plant cable shields shall be bonded directly to the TMGB or the closest TGB.

3.3.3 Cable Stubs

All shields of cable stubs shall be bonded to a TGB located on the frame.

3.3.4 Shields

The shields of all incoming cables shall not be bonded across the splice to the cable stubs.

3.3.5 Protection Assemblies

The protector assemblies shall be mounted directly on the vertical frame ironwork. The assemblies mounted on each vertical frame shall be connected with a No. 6 AWG copper conductor to provide a low resistance path to the TGB.

3.3.6 Manholes

The shields of all cables in each manhole shall be bonded together by a bonding wire or ribbon. At intermediate manholes, where the cable is pulled through without a sheath opening, bonds are not required. If the manhole has a lacerating bonding ribbon, the shields of spliced cables shall be attached to it.

3.4 CUTOVER AND RECORDS

All necessary transfers and cutovers, shall be accomplished by the Contractor.

3.5 ACCEPTANCE TESTS

The Contractor shall provide all personnel, equipment, instrumentation, and supplies necessary to perform all required testing. Notification of any planned testing shall be given to the Contracting Officer at least 14 days prior to any test; testing shall not proceed until after the Contractor has received written Contracting Officer's approval of the test plans as specified. The test plans shall define all the tests required to ensure that the system meets technical, operational, and performance specifications. The test plans shall define milestones for the tests, equipment, personnel, facilities, and supplies required. The test plans shall identify the capabilities and functions to be tested.

3.5.1 Copper Conductor Cable

The following acceptance tests shall be performed in accordance with RUS REA Bull 1753F-201 (PC-4):

- a. Shield continuity.
- b. Conductor continuity.
- c. Conductor insulation resistance.
- d. Structural return loss.
- e. Cable insertion loss and loss margin at carrier frequencies.
- f. Shield ground for single jacketed cables.
- g. DC loop resistance.

3.5.2 Fiber Optic Cable

Two optical tests shall be performed on all optical fibers: Optical Time Domain Reflectometry (OTDR) Test, and Attenuation Test. These tests shall be performed on the completed end-to-end spans which include the near-end pre-connectorized single fiber cable assembly, outside plant as specified, and the far-end pre-connectorized single fiber cable assembly.

3.5.2.1 OTDR Test

The OTDR test shall be used to determine the adequacy of the cable installations by showing any irregularities, such as discontinuities, micro-bendings, improper splices, for the cable span under test. Hard copy fiber signature records shall be obtained from the OTDR for each fiber in each span and shall be included in the test results. The OTDR test shall be measured in both directions. A reference length of fiber, 1 km (3280 feet) minimum, used as the delay line shall be placed before the new end connector and after the far end patch panel connectors for inspection of connector signature. The OTDR test shall be conducted in accordance with EIA ANSI/EIA 455-81A-91 for single-mode fiber. Splice losses shall not exceed 0.1db. Attenuation losses shall not exceed 0.5 dB/km at 1310 nm and 1550 nm for single-mode fiber.

3.5.2.2 Attenuation Test

End-to-end attenuation measurements shall be made on all fibers, in both directions, using a 1300 nanometer light source at one end and the optical power meter on the other end to verify that the cable system attenuation requirements are met. The measurement method shall be in accordance with EIA ANSI/EIA/TIA-455-53A.

END OF SECTION

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